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USE OF STEEL IN CONCRETE CONSTRUCTION.

THE use of steel in building and concrete construction is of comparatively recent origin, it having been introduced in Europe just twenty-one years ago, and at a later date in this country. Its use has been the signal for greater achievements in the construction line and the introduction of economies hitherto impossible. It is still in the infancy of its development, hence it is impossible to reduce the methods thus far employed to an exact science. A large amount of valuable experience has been evolved in the use of steel in its various forms, but none has yielded more satisfactory results than that form known as expanded metal, of which some idea may be formed from the accompanying illustrations.

The high price of cement in Europe led to a series of investigations, conducted by M. Monier, who sought to combine with cement some factor which would materially reduce the cost and permit of a wider use of cement in construction work. He struck upon the solution of the problem in 1880 when he used some form of steel. This added the tensile element to a material which lacked it. During the past decade this system, in some form or other, has sprung into general use, and many combinations of steel and concrete have been the result, in some of which the steel was intended to act entirely in tension, in which case it was distributed through an area of minimum tension of the section in question, and others in which the steel acted under transverse stress. Both methods possessed certain advantages, but it is an acknowledged fact to-day that the best practice is where concrete and steel are used in combination for tension purposes only.

Among the varied forms of steel which have been used in connection with concrete construction, expanded metal has widened the field of usefulness of this sort of material. This metal combination has been extensively used on both sides of the Atlantic in building reservoirs and water filtration plants. For instance, expanded metal was used in the construction of the water reservoir in Antwerp, Belgium, the immense filtration plant at Albany, N. Y., and many other places in a similar way. It was early demonstrated in the use of steel and cement that the latter acted as a preservative of the steel, even when the cement was immersed in water. This was demonstrated in the instances just mentioned and many others where rust has not occurred. Besides this quality in the combination the cement greatly stiffens the steel, thus bringing its maximum strength into requisition.

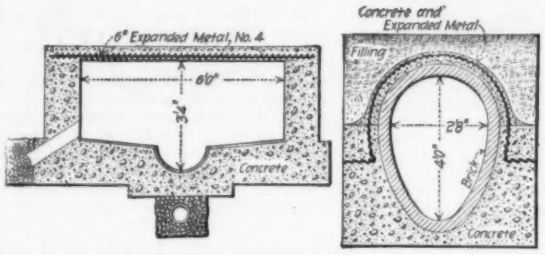
This form of steel was used throughout the Mills Hotel No. 1, in New York city, which is thereby made absolutely fireproof. The thin partitions, which divide the interior space on each floor of that poor man's hotel into rooms, are made possible only by the use of this metal. It not only makes the building fireproof, but capable of being maintained in a perfectly sanitary manner. The metal has been used extensively in the construction of some of the ornamental work in Philadelphia's city hall as well as other portions of that immense building, which demonstrates, in part only, the varied uses to which it may be put. The recent development of the cement industry and the greatly diminished cost of this material, especially when used in connection with steel, has made it the winning competitor of common masonry for a multitude of uses. Moreover, this metal has enabled the engineer to demonstrate that, where ornamentation or structural effect is not required, he can accomplish ninety per cent of his work, formerly done in either brick or stone, by the use of properly proportioned concrete mixtures. What is still more satisfactory, a wide observation of the use of steel with concrete has shown that there has been a saving of from twenty to eighty per cent of concrete, according to conditions.

The combination of steel and concrete has almost revolutionized building methods of a quarter of a century ago. Among its first uses was for fireproof floors. In the beginning it was considered a great achievement to build a slab floor upon a system of iron framing over spans averaging five feet, the slab being three and one-half inches in thickness. Very soon after contractors used slabs of the same thickness to cover a span of eight feet in length, which was considered a great achievement, but to-day they are being used to build floors of metal and concrete on spans sixteen, eighteen and twenty feet in any direction, and, in some cases, with only a small quantity of iron work, aside from the columns which sustain the load.

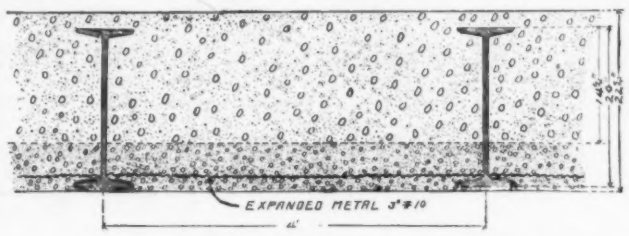
There has been an extensive use of this material throughout the United States and Europe for the construction of piers, sewers, bridges, subways, reservoirs, tunnels, conduits, septic tanks, manhole covers and other classes of work. In fact, this material has been put to use in almost every class of work in municipal construction or elsewhere. The first large general use of it in civic building was in the city of Chicago, some years ago, when it was used to reinforce a concrete bed underlying asphalt pavement. The subsoil in that city is practically a sandbed over which there was usually laid a heavy bed of concrete, upon which was placed the asphalt. By the combination of steel and concrete it was demonstrated that the thickness of the foundation could be materially reduced and the system was used in the laying of many miles of pavement.

A recent test of the use of steel and concrete in combination took place at Boonton, N. J., where the engineer of one of the largest water companies designed a section for a water conduit. It was made elliptical in form, eight feet six inches in diameter. To build this arch, as designed, required two cubic yards of concrete per lineal foot of pipe section. A

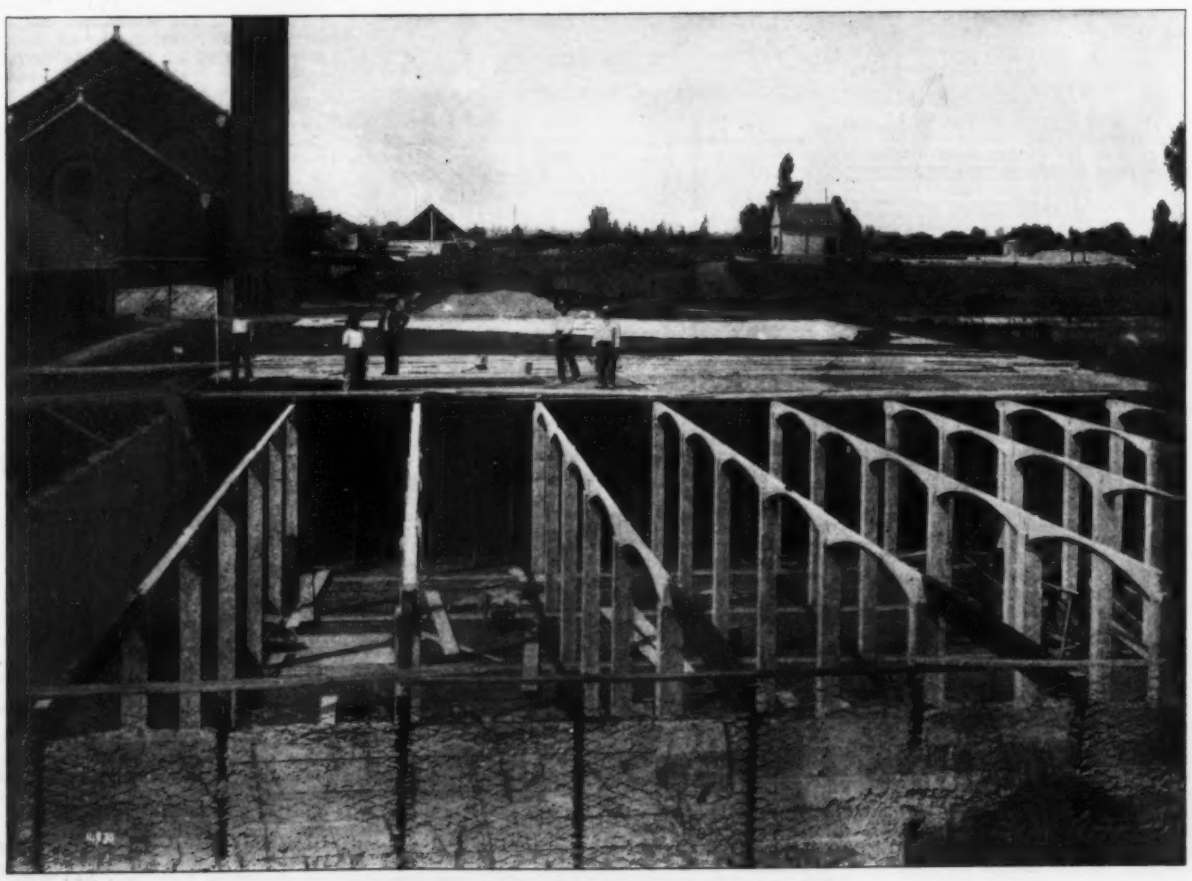
WATER CONDUIT AT BOONTON, N. J.



ADAPTATION TO SEWER WORK.



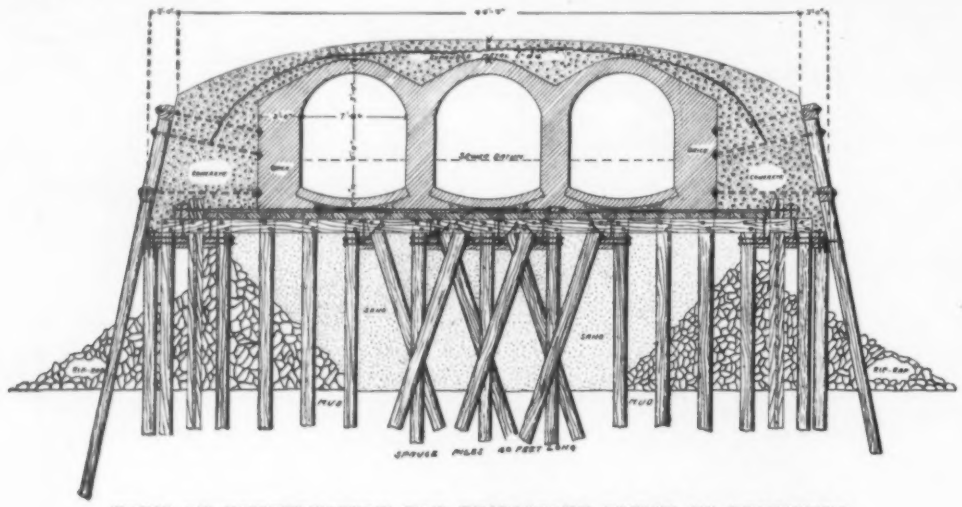
USED FOR ROOFING SEWER IN BUFFALO.



USED IN CONSTRUCTION OF WATER RESERVOIR IN ANTWERP, BELGIUM

section ten feet in length of the same weight-carrying capacity, and practically the same shape, was constructed of reinforced concrete, which section consumed just a trifle over one cubic yard per foot of pipe section, as compared with double that amount as constructed after the old method. The reinforcement employed in this instance was expanded metal of three-inch No. 10 gage. When tested in a thoroughly scientific manner it was found to have double the estimated value of the concrete section as originally designed. Assuming the concrete to be worth $7 per yard, there was that amount saved less a cost of about one dollar for the steel used on each yard of the section constructed.

From the standpoint of durability as well as that of economy the use of steel in combination with con-



FORM OF CONSTRUCTION FOR TRIPLICATE SEWER IN BROOKLYN.

crete commends itself for modern construction work and relegates to the rear the old-time methods which have obtained for centuries.

VANISHING VENICE.*

By Alfredo Melani.

Yesterday it was the Ducal Palace whose static conditions, although exaggerated by an official report, stirred the public. To-day, apropos of a new bridge over the Lagoon, it is the very integrity of Venice which has been brought into discussion, and the diabolical cry, "Venice is vanishing," is heard on every side with an insistence which would be culpable if it did not correspond with the realities, to the general condition of things that are in open contradiction with the rights of art, of history, and of the beauty of the most original city of Italy. Venice is vanishing—that is, the Venice of the Doges, with its *calli*, with its *campi*, with its little palaces, which have the delicacy of lacework—it is this Venice which, from day to day, is being wiped out as if it were merely a question of a city whose importance was a negligible quantity. Unfortunately, even Venice, like Florence, Rome, and Naples, has need of a good general plan of sanitation. If there is in the world a difficult city to be sanitated, Venice is that city. In fact, from the time that the study of the plan of sanitation was proposed, protests were raised on every side. These were the voices of artists, scholars, and the admirers of the beautiful who were united by a sentiment of fear and disapprobation; so the Italian government, in order to soften an agitation which tended ever to expand, instead of leaving to the municipality of Venice the exclusive responsibility of the sanitation of the city, arranged that a mixed commission should be chosen in the interest of art, of history, and of the public health, in order that it might study the questions which were concerned in the sanitation of the city, and at the same time ordered that this commission should present its conclusions within a reasonable length of time.

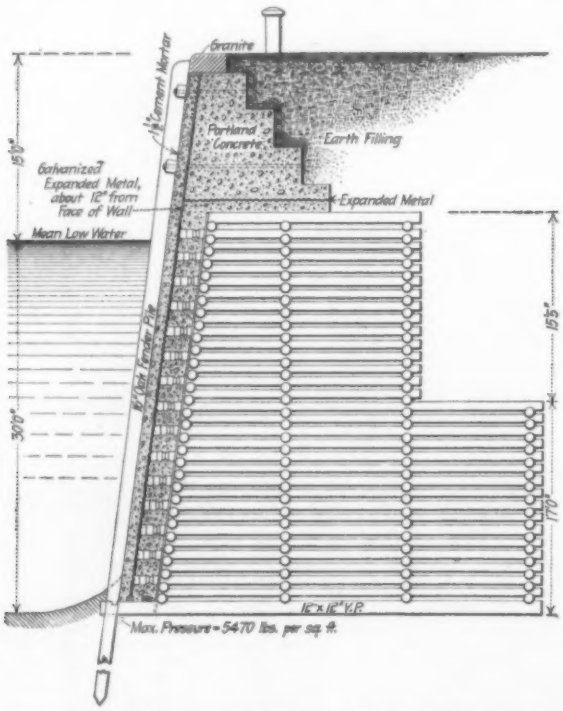
This was done, and the official report was the object of discussion, for it showed to the public a series of truths, which, alas, were found to be in perfect disaccord with the feelings of the artists. It goes without saying that modern life has new demands, new needs, which cannot be neglected, and the commissioners affirmed that the bad dwellings and the great agglomerations of individuals are the most pitiless enemies of the healthfulness of life in Venice. Therefore, these habitations must be made more humane, and opposition must be made to all overcrowding, if it is really hoped to solve the matter of the regeneration of Venice; and since light and air are the essential elements of health, the suppression of several alleys is imposed on those who study the problem. To enlarge most of the streets of Venice would be to destroy the city, but enlargement may be carried out with prudence and discretion without doing violence to the picturesque character of the city, while at the same time respecting the tortuous movement of the streets; for right lines are not for Venice, a city without horses, without carriages. Already sketches after this programme have been prepared, and the result has been disastrous from the æsthetic point of view. And this is why commissioners, historians and artists find themselves in opposition to the sanitarians, and these last proclaim, supporting themselves by figures, that the healthfulness of Venice is higher in those places where the typical Venetian aspect is most sensibly represented in its lines and its deplorable habits.

The report has been forgotten, and an architect member of the commission, who is always in relation with the government, particularly in these later days, declared, in a letter to a daily journal, that the Ministry, as well as different members of the commission, desired that the report should be allowed to sleep; and, in fact, it does sleep, and no one as it appears will waken it. In the meantime Venice continues to find herself in danger, and her artistic integrity appears to be dissolving like a snow statue in the sun. The ruins cannot be counted, whether in the center of the city or in those quarters of the city far from the center; it is true that the matter relates to picturesque ruins—ruins which are the especial loves of the impressionist painter and the dreamy poet—but the condition in which some among them are found is not reassuring to those who, apart from all considerations of beauty, are interested in stability. It suffices to make a trip along the Grand Canal to gather enough facts bearing on the subject which interests us. The color of Venice no longer exists except in the soul of the poet; the passage of the years as they flow by is going to finish the work of destruction, and the moderns show themselves insensible to this destruction, which, moreover, is often fortified, so to speak, by the "*soins*" of these same Venetians, who have forgotten their race and the might of their ancestors.

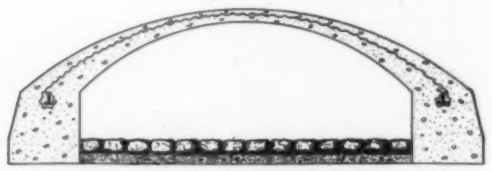
On the Grand Canal we meet several of those pretty façades with those unforgettable "*finestrati*"—little buildings with from four to six windows partly barred by walls which rise between the slight columns of these "*finestrati*"; Gothic palaces with Venetian blinds; Gothic palaces with modern additions and little isolated windows, of an elegance at once an æsthetic pleasure and a model of good taste, alternating with balconies of iron, balconies even of a commercial type, which are a real offense to the most elementary laws of propriety. And halt before one of the palaces of the municipality itself still on this Grand Canal, once called the finest street in the whole world, a clock is here so placed that its effect is so disastrous that the municipality should not allow it in the case even of a private house. Next direct your glances to the Museo Correr, quite near; beside it rises a terrible roof, the Pescheria, or fish market, a construction with columns of a kind which would do well enough in a village, but on the bank of the Grand Canal shock the view even of those who are most insensible to æsthetic pleasures. For a long time people have been thinking of replacing this structure with a building which might be in proper relation with the beauty of the place, but long discussions have not yet resulted in anything real.

There exists, however, a project for a fish market prepared by M. Rupolo, an architect to whom has been confided the restoration of the Ducal Palace, and M. Laurenti, a Venetian painter full of suggestiveness and sincerely in love with his art; and we can only hope for the realization of their scheme, which will destroy forever the ugliest building on the Grand Canal. And think for merely a moment that this old Pescheria, besides not being far from the Museo Correr, is almost facing the celebrated Ca' d'Oro, the most charming of the Venetian edifices which formerly gave life to the Canal and afforded to the eye the joy of the most exquisite forms which can be imagined. Thank God, the Ca' d'Oro is going to be restored at the expense of Franchetti, its present proprietor; and in the midst of the ruins, the dangers, the disgraceful additions on the Grand Canal, here the eye rests with satisfaction.

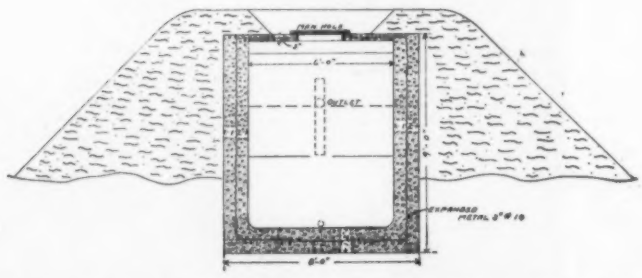
Listen to what the Venetian Section of the Italian Society for Public Art has to say, for on the matter of Venice it uses words of an exemplary frankness and directness. Artistic Venice has no more time to lose, it says. Destroyed are its private galleries; migrated are its paintings, its bronzes, its well-heads, its most beautiful friezes; exported are its mantelpieces, its doors, its mural decorations and the ceilings of its ancient richness. Except for a few palaces, still preserved, there remains to-day only the curtain of the façades, and it is precisely to save this glorious remnant that provision must be made. To succeed in this it is not necessary to demand new laws; it is enough to revise those which exist and make them respected without exception. Respect for the law is really one of the most important points in the question. In fact, Venice, like all the cities of Italy, has its Regulation of Public Edility, respect for which might be enforced in favor of the integrity of the city, much more than would appear at first sight. Do you know how many pieces of carved marble, whether they come from the façades or the interior of the palaces, have been taken away and sold, to the great damage of the artistic patrimony and exterior beauty of Venice? An incredible quantity. I was in London last month, and, in visiting anew South Kensington Museum, I was thunderstruck at the number of Venetian marbles and sculptured stones. It was the love of Ruskin and all that was Ruskinian which urged the English to bring to London everything Venetian



USED FOR RETAINING WALL IN BOSTON, MASS.



EXPANDED METAL EMBEDDED IN CONCRETE.



WALL ADAPTED TO SEPTIC TANK CONSTRUCTION—CROSS SECTION OF ONE BUILT AT TANNERSVILLE, N. Y.

* From The Builder, London.

that they could get hold of whenever such things were put up to auction by the Venetians; and the English, thanks to the condescension of the Venetians and the indifference of the authorities, little by little have drawn to the Museum on Cromwell Road, and even to the Museum in Trafalgar Square, not only marbles and carved stones, but also the paintings from the Pinakotheks of Venice.

APPARATUS FOR MAKING SMALL MAPS.

By H. M. GILTAY.

THE making of small maps for military and other purposes can be done with the data which a vehicle of two wheels procures, if the movements of the wheels in proportion to each other are registered exactly.

It is generally known that the length of a road or boundary can be found by a tachometer applied to one of the wheels of a vehicle, but the other fact that also the map can be determined by the movements of the wheels in proportion to each other has, as far as I have ascertained, not been taken into consideration or used, though it rests on very simple grounds.

With every turn of the road one of the wheels will make more revolutions than the other one, which enables the direction in which the vehicle moves, if exactly registered, to be determined.

On this idea I constructed a small apparatus which draws or sketches automatically a design of the road the vehicle travels over a table, on a scale of 1 to 10.

For those who would like to work out this idea practically, possibly for making small walking maps or to control a survey or to know the way which a water car or other vehicle has gone, the following description of my instrument is given:

My intention is chiefly to show a method by which this problem may be solved. It is possible that others may find a more practical one.

My apparatus consists of two wheels of a diameter of 1 decimeter placed at a distance of 1 decimeter from each other, each wheel being fixed to an axle of ½ decimeter, at the other end of which is fixed a small wheel of 1 centimeter diameter.

Both half axles are fixed in the same line, as shown on the design.

On the small wheels of 1 centimeter, placed at a distance of 1 centimeter apart, is laid a slip of paper held down by two contra-wheels, while a small immovable lead-pencil is pressed on the paper between the small wheels.

By moving the apparatus on a table, each large wheel makes revolutions equal to those of the small wheel to which it is fixed, and thus the small wheels move the paper in all directions, exactly like the road which the large wheels traverse, while the lead-pencil draws an exact design thereof on a scale of 1 to 10. It is clear that according to the purpose another scale might be used.

On very hilly ground the design will of course want a correction.

FATALITIES OF MOUNTAINEERING.

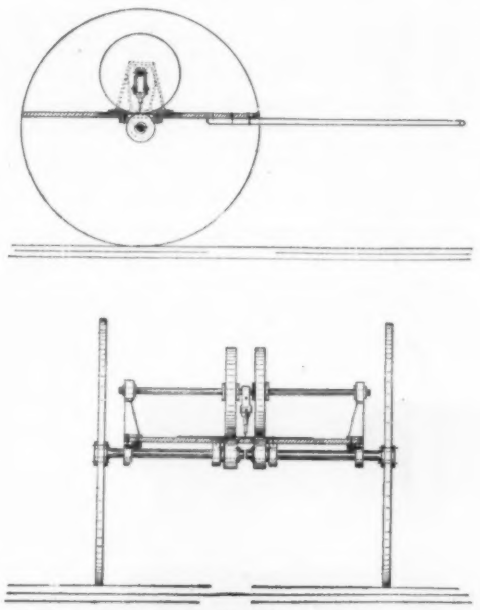
DETAILS have now been received respecting the death of Mrs. Wickham Smith, of Brooklyn, while climbing in the Alps. With her husband, of the law firm of Curie, Smith & Maxwell, she had been stopping at the Schweizerhof, and started for a trip over the Furka and Grimsel, to the glacier at whose foot the River Rhone begins in many streamlets, the largest of which issues from a beautiful blue arch nearly a hundred feet high. While leaving the famous ice cavern, hewn grotto-like in the glacier, a huge falling icicle or block struck Mrs. Smith on the back of the neck. She became instantly unconscious and survived less than a half hour. This might seem an accident of almost the same kind, and as rare, as being killed by bricks falling from a street scaffold, yet it is in fact one of the greatest dangers of Alpine climbing. On some slopes when the sun softens the surface the release of bowlders and fragments is almost a bombardment of the lower levels. Scarcely a week earlier a Frenchman—M. Prochet—met a similar death. He saw the fall of the rock which killed him, but made no attempt to escape it. The bowlder came leaping and crashing toward him, plainly seen by all his company, who cried out to him. But he stood as though fascinated, and was struck full in the chest. He was thrown backward with terrible force, his body ricocheting down the glacier and his head striking each irregularity. Although he broke no bones, and received scarcely a scratch, his scalp was completely torn off, but doctors say he never knew what happened to him.

An even more shocking accident, and one more strictly "mountaineering" than being killed by a falling missile, occurred in the last week of July. A party of five, including two ladies of London, started with two guides to climb the Matterhorn. One of the ladies said, "What a view!" and turned as for a wider look. In the movement she lost her balance on the ice, and with it her nerve. She slipped, dragging with her her two companions on the rope. They transmitted the entire strain to the guide with a terrific jerk. But he was expecting it, and was braced with his ice ax. For a moment he held them all above an abyss, and then was torn away. The others in the party, two gentlemen, seeing the fall, involuntarily started to help the women, forgetting that they were roped to another guide, whose promptness in throwing the rope around a rock saved the lives of his party. When the relief party arrived they were surprised to hear shouts where they thought to find only corpses. The first party had fallen a thousand feet, yet one lady and the guide survived, the latter being insane through horror and anxiety for his charges.

These instances give point to these grim statistics issued by the Alpine Club this year: In 1895 nineteen people lost their lives, while the following year saw twenty-four victims. Again, in 1897, the number increased to thirty-four; to thirty-seven in 1898; to forty-seven in 1899, and last year the record was reached with forty-eight fatal accidents. Unfortunately this year points to an increase of victims, as up to date a higher percentage of accidents has been attained than in former years.

The Matterhorn alone has claimed thirteen victims in thirty-six years. The first, the Whymper accident, in 1865, was followed by two deaths in 1879. Dr. Moseley, an American, fell on the Furggen Glacier because he thought he could dispense with the rope. When he was found it shocked one of his friends to find hardly any nails in one boot. The year 1886 was noted for another death, through inexperience. Borckhardt and Davies, two friends, said they had heard ladies and youths had climbed the Matterhorn, and they would. Borckhardt died on the mountain. In 1890 Herr Goehrs, a young man from Strasburg, and two friends lost their lives; the opinion was at that time want of experience. Up to now the accidents, without exception, had occurred on the east face—the Zermatt side. Late in the same year the famous guide, Carrel, died from exhaustion on the Italian side, having nobly held out to the last and saved the whole party he was responsible for, who had been lost in a snowstorm two days. In August, 1893, young Seiler and his guide lost their lives on the south side. Seven years elapsed, and last August the guide Furrer was killed on the Matterhorn ice gulley by falling stones.

It is interesting to analyze the accidents, and to note how far want of skill is responsible for the deaths. On the Matterhorn there have been nine affairs in which there has been loss of life. The first and greatest of all was probably due to want of skill in one of the climbers, Mr. Hadow, who was young and inexperienced. The second fatality was due to the abandonment of a sick guide in a hut, 13,000 feet above the sea, by his comrades; the third was due to pure carelessness, the climber having few nails in his boots; the fourth was caused by the weather, Mr. Borckhardt being left by his party dying on the slope of the mountain; in the fifth case two young and inexperienced guides were killed with their "Herr," cause unknown; in the sixth J. A. Carrel died of exhaustion after bringing his party down to safety through a terrible storm; in the seventh two young Zermatters fell, after they had been noted to be going carelessly; the eighth case was that of Mr. Stoggett's party, where no want of care is to



APPARATUS FOR MAKING SMALL MAPS.

be imputed; in the ninth, and last accident, the guides were too few for a large party and the climbers were novices. Thus, while in climbing, as in war, skill does not absolutely remove the peril, it certainly minimizes it.

The explanation of such a death roll is simple. Mount Washington is perhaps the most famous of our Eastern peaks, yet there are few who have ascended it who have not been disappointed. The aggregate height—6,288 feet—does, indeed, seem an understatement, owing to the configuration of the plateau from which it rises, not in bold leaps, but in a succession of piles of bowlders, or broken rock. A pile, however, large and containing however many millions of stones, seldom exceeding the size of a loaded hay wagon, is much less imposing and dangerous than steep, massive cliffs. The travelers who at this season pass between Capes Trinity and Eternity, on the Saguenay River—a noble stream which should be seen by all who think the Hudson has no peer on this continent—get an impression of mountainous grandeur surpassing that given by Washington's greater height. There are but few places on Washington which it seems to require more than industry to climb. But looking at the Saguenay capes from the distance of the decks of the steamer which passes between them it does not seem possible that foot of man has ever trod them or as though any wingless creature could ascend their faces. But far above their heights the Matterhorn thrusts an icy needle into the air 14,836 feet. A similar challenge on this continent is afforded by Mount Assiniboine, among the Canadian Rockies. It is still a virgin, unconquered peak, despite many attempts to climb it. This year Henry Bryant, formerly president of the Philadelphia Geographical Society, reached 11,125 feet upon its side, but the peak has probably never been trodden. In North America there is no elevation of 10,000 feet east of 104 degrees west longitude. Westward of that degree there are no fewer than 412 peaks of that height or over, and the pioneer of the Matterhorn—Whymper—is said to intend accepting the challenge of the Canadian Rockies. The world's highest mountain is supposed to be Everest, in the Himalayas, 29,002 feet. Still, some say Mount Hercules, in New Guinea, is 32,786 feet high.

It thus appears that not height alone makes the danger of mountain climbing. Steepness and quality of surface are also factors. "Mountain sickness" is negligible below 10,000 feet, and not serious below 16,000 feet. Above that even the stoutest and most experienced can scarcely endure the nausea, dizziness, faintness, and even bleeding of the mucous membranes due to the rarefied atmosphere. Presumably women are liable at much lower altitudes to what attacks the strongest men, sometimes unexpectedly. When women—speaking generally—and some men attempt climbs such as cause accidents, their guides regard them as so much luggage. For a guide to decline to take them is not only to lose his fee, but to give a check to mountain-climbing ambition at large. But mountains can no more be trifled with than the ocean. Both have their storms, both have dangers which are the delight of the skillful and experienced, but which are deadly to rash experimenters. And the unexpected lurks for the wary and unwary alike in the surf and above the clouds.

Why seek such dangers is the natural question of the unadventurous. There is no answer except in the breast of the adventurer. To swim amid the white-capped combers, to shoot big game, to ride out a storm in a well-found bottom, to climb unclimbable heights, are among the highest pleasures to experience or to remember in this life—for those who like them. To those of different tastes such sports are simple madness.—The New York Times.

PROGRESS IN ALUMINOTHERMY.

AT the recent meeting of the Verein Deutscher Eisenhüttenleute Dr. Goldschmidt delivered an interesting address, accompanied by experimental demonstrations, showing the recent extensive developments of the process, and from the report of the address in Stahl und Eisen we make some abstracts, says The Engineering Magazine.

Prominent among the applications of thermite, as the Goldschmidt alloy is called, may be noted the reduction of such metals as chromium and manganese without the presence of carbon. This reduction is effected in large crucibles, holding several centners of metal, and the operation is rapid, requiring scarcely more than half an hour for a charge. The resulting chromium, being entirely free from carbon, is especially valuable in the manufacture of chrome steel, while the manganese produced in a similar manner is used for making manganese bronze. Chromium prepared in the ordinary manner contains 10 to 12 per cent of carbon, and its addition to steel materially modifies the carbon content.

This pure chrome is also useful in preparing other alloys, while pure titanium may be made and used in a similar manner.

Various useful alloys may be made with pure manganese, the absence of iron and carbon being especially important, and there is every reason to believe that the commercial production of these metals in a pure state by the Goldschmidt process will open up some valuable alloys hitherto not obtainable.

Both nickel and cobalt may be reduced by combustion of aluminium, and while the cost of cobalt renders it unavailable the production of pure nickel is most desirable. In like manner we may reduce boron, vanadium, etc., and an entire new field of metalizing is opened by this possibility of working with a metallic fuel producing a remarkably high temperature.

The practical uses of thermite as a means of melting or welding have become more and more extensive. By the use of special clamps and devices a number of operations, otherwise difficult, are readily performed, and as a means of repairing broken or defective parts, the use of thermite bids fair to become generally employed. By the use of a convenient and portable jacket and clamp, it is possible to weld the joints of pipes for gas, water, or steam, after the pipes have been placed in position, the joints in such cases being as strong under test as the other portions of the pipe. The advantages which the possession of such a material gives the engineer far removed from supplies and repair shops, as at sea, can hardly be enumerated.

The employment of thermite for welding the ends of rails, has already been discussed. The value of continuous rails for the prevention of stray currents and consequent electrolysis of water and gas pipes is again emphasized by Dr. Goldschmidt. Not only for electric tramways, but also for the rails of main line railways. In the case of tramways the rails are imbedded in the earth to an extent which prevents great and sudden changes in temperature, and hence it has been found practicable to weld long lengths of rail, with but few breakages from expansion or contraction. On main lines, however, the rails are exposed to atmospheric changes of temperature, but in spite of this it has been found practicable to join several lengths of rail by welding and thus materially reduce the number of open joints. In tunnels, where the temperature is practically constant and where the elimination of joints is an especial advantage, the length which may be continuously welded is much greater.

Dr. Goldschmidt describes a number of instances in which the use of thermite for repairing broken pieces has been successful and advantageous. New journals have been welded to heavy rolls, broken pump-rods have been joined, and a number of structural combinations successfully united by means of this convenient application of intense local heating.

It is not to be expected that such an expensive combustible can be used in ordinary cases, but for special work, and for use in emergencies thermite offers many possibilities.

It is interesting to note that, as aluminium is now practically all produced electrolytically, the heat derived from its combustion may have its origin traced to the source of energy from which the electric current was produced, either water or steam power, and hence aluminothermy, as it has been termed, is practically an application, after several transformations, either of the heat of the sun, by which the water of Niagara, for example, was raised, or of the fuel burned under the boilers of some generating station.

IMPROVING CIRCULATION IN BOILERS.

WE have during the past week had an opportunity of witnessing practical tests of a new arrangement for securing improved circulation, and consequently increased efficiency, in steam boilers. The results of these trials were favorable, and the following are a few particulars of the apparatus.

The invention is known as Makins' patent cone system, the cones being made by Makins, Limited, Victoria Building, Manchester, and Irwell Works, Radcliffe. The general features of the arrangement will be readily understood by reference to the accompanying illustrations, Fig. 1 being a separate view of one of the cones which give the system its name, and Fig. 2 showing a longitudinal section of a flue fitted with a series of these cones. From this it will be seen that the system essentially consists in inserting a number of conical shells with hollow walls in the furnace flues—the usual number being five in each flue. These cones, which are manufactured of cast malleable iron, with a tensile strength, it is stated, of 22 tons per inch, communicate with the water below and above the furnace flue by means of pipes. In addition to the five cones of the form shown in Fig. 1, in each flue an extra cone, of D shape, the first of the series, as illustrated in Fig. 2, can be included, the bottom half of this cone forming a bridge over which the gases pass before reaching the first of the ordinary cones. It is claimed that the whole of the water in boiler makes a complete round of circulation every few minutes, and is consequently at practically the same temperature throughout. It is found in practice that with the conical shells in the flue the draught is reduced to a considerably greater extent than under normal conditions, and the rapid circulation obtained prevents the cones being filled up by incrustation, while the formation of scale on the plates of the boiler is also reduced to the minimum. Apart from the advantages of increased circulation, the enlarged heating surface materially helps to increase the steaming efficiency of the boiler. Drier steam is, it is said, also produced, and priming prevented. Installations have been equipped comprising sixteen cones in a flue, or thirty-two cones in all, and in some instances brick flues have been entirely dispensed with, the boiler being simply dropped on three cast-iron trestles, and the gases taken straight away from the end of the flue tubes into the chimney uptake. The temperature of the gases during their passage from the grate has been reduced to from 450 to 500 deg. at the end of the boiler, thereby approaching as nearly as possible to the theoretical boiler in the economical utilization of heat. The improved combustion obtained is proved by an analysis of the flue gas at the end of the boiler, and it is found that any gases that may have been extinguished in passing along the flue are re-ignited before passing the last cone. The test referred to above was carried out on a Lancashire boiler 24 feet long by 7 feet diameter, one furnace being fitted with four cones, and the other being of the ordinary type. Each side was tested separately, and 300 pounds of coal consumed in each case, the furnace not in use being sealed up, while the other was at work. From an examination of the water level at the beginning and end of each test, it was found that the volume of water had dropped 30 per cent more during the test

FIG. 1.—END VIEW OF FLUE.

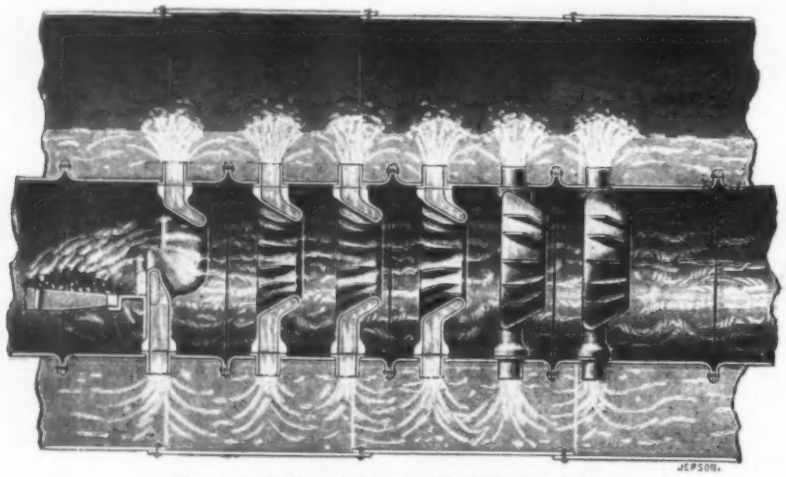


FIG. 2.—SECTION OF FLUE WITH CONES.

with the application of the cone system than in the plain furnace.—For our engravings and the foregoing particulars we are indebted to The Engineer.

THE INTERNATIONAL PETROLEUM CONGRESS.

OF the many congresses held at or in connection with the Paris Exhibition, few are possessed of greater interest to the automobilist than that relating to petroleum, if for nothing else than the large number of papers dealing with almost all the aspects of this important industry by the leading experts of Europe and America on the subject, to which the congress gave publicity.

Needless to say the social side of affairs was not neglected, being opened by a lunch given by the Russian petroleum exhibitors under the presidency of Dr. P. Dvorkovitz. This was followed by a dinner at the Hotel Continental. At both of these functions a considerable number of toasts of the usual kind were proposed, and the situation was certainly not devoid of a certain element of comedy. No two industries are keener rivals and competitors for the European market than the oil industries of America and Russia. Dr. Dvorkovitz very effectively succeeded in disguising this underlying but vital fact as he proposed the health of the "American Oil Industry," and pointed out the enormous benefits conferred upon the world by the energy of Mr. Rockefeller. The American representative on the occasion of the dinner expressed himself in somewhat similar terms in regard to the developers of the Russian petroleum industry and the budding French Algerian petroleum industry. It was all very courteous and all very nice, but each of these rivals must have been thinking all the time what a splendid field the world would be if the other gentlemen were all out of the way.

The papers read at the congress were many of them, as already pointed out, of high interest, particularly those dealing with the oil fields of Roumania and Japan, which countries as affording sources of petroleum will probably be unfamiliar to many of our readers. Able papers were also read by Dr. Day on the Pennsylvania oil fields, and communicated by the great Russian chemist, Markownikoff, on the chemistry of Russian petroleum. This latter paper is of such importance and interest that we propose to deal with it at length on a future occasion, confining ourselves at present mainly to a résumé of the information provided concerning the Roumanian oils and the oils of Japan.

The chemistry and composition of the Roumanian oils were very ably dealt with by Messrs. C. Alimanestiano and L. Edeleano.

The Roumanian petroleum industry is of comparatively recent growth, and, though for the present rather strangled by its powerful Russian competitor, is still growing.

The chemical investigations carried out by the above-named gentlemen are very exhaustive, and especially worthy of notice is their method of treatment of the undistillable residue obtained after all the more volatile products in a fractional distillation have been driven off. The distillation was then continued at the same temperature, viz., 300 deg. C., under a partial vacuum produced by an Alvergniat pump, it having been found that raising the temperature above 300 deg. C. to attempt to obtain further distillation at atmospheric pressure gave no reliable results, as the oils decompose into secondary products. Of interest to automobilists is the fact that the average yield of the oils in so-called benzine varies from something under 10 per cent to upward of 20 per cent.

The chemical composition of the Roumanian crude petroleums distilling at 150 deg. C. consists of a small percentage of oxygenated compounds with normal pentanes, hexanes, and heptanes, certain arborescent paraffins, and very small quantities of amylene. The percentage of members of the ethylene series is rather small. The oils distilling at 180 deg. C. contain a higher proportion of open-chain hydrocarbons.

A very exhaustive paper on the petroleums of Japan was contributed by Prof. Shin-ichi Takano, of Tokio. Japanese petroleum appears to occur at a large number of different places, but they all strongly resemble one another in chemical composition. They all apparently belong to the C_nH_n series of hydrocarbons, and their gravity and refractive indices point to their belonging to the methylene or naphthene group of the ethylene series rather than the actual ethylenes. The percentages of sulphur and nitro compounds are very high, and the calorific power of the crude oils higher than any of the American or Russian petroleums. The amount of aromatic hydrocarbons varies from 1 per cent to as much as 40 per cent, belonging mainly to the benzol, toluol, and xylol, and to the high benzol groups. No oxygenated compounds are found to exist, and the examination proves that the Japanese oils are more akin to the Russian and Californian oils than to the Pennsylvanian and other American oils.

The oil fields of Italy also came in for some description at the hands of Signor Attilio Muggia. His account was mainly connected with their geological and local occurrence, and he did not furnish any details as regards their chemical composition. The output of some of the wells seems to be considerable, one spring at Velleja, in the northern part of Italy, which is at present worked by a French company, turning out some 3,000 tons of oil annually. The oil field appears to lie in a district extending for about 150 miles from Piacenza to Jorio, and along the Apennines toward the neighborhood of Modena and Bologna. In the Province of Bologna deposits of ozokerite are found.

A great deal has been written on the chemistry and geology of the Pennsylvania and Ohio oils, but Dr. Day's paper dealing with the variation in character of these oils according to their geological occurrence presented several novel features of interest. One of the principal variations in the crude oils which Dr. Day was able to connect with the strata in which they occur was the variation in color. The oils occurring in the Devonian shales, where there are no other shales adjacent, are usually black. The oils occurring in the sandstones vary from black through all shades of green and red to almost pure white and similar variations occur in their other physical properties, such as specific gravity and viscosity, and their percentage of benzine.

Dr. Day also recounts the result of a number of experiments made on crude oils filtered very slowly through fuller's earth. This process seemed to approximate in the results it gave very closely to distillation, the first filtrate consisting mainly of so-called benzine, the later filtrates being of middle grade, and the final filtrates semi-solid vaseline. "This variation," says Dr. Day, "is greater than any we encounter in nature, and points to the conclusion that the Pennsylvania oils, which were originally of one uniform composition, attained their present variation by filtration through Devonian shales." Dr. Day further suggests that the process of artificial filtration may be ultimately found to be a superior method of separating the constituents of crude petroleum through distillation.

Other papers dealt with the industries of Canada and California, and with such subjects as the general classification of petroleums from a chemical point of view. A special paper by A. Fauck, on "Recent Improvements in Drilling Machinery," is of interest to the mining engineer, especially his description of the new form of steel drill which enables the costly and troublesome diamond drill, hitherto deemed indispensable, to be superseded. He sums up the advantages presented by the new method as follows: (1) The possibility of reaching any depth at which a good set of rods will support its own weight, and at the same time of obtaining cores without the diamond; (2) boreholes with diameters from 24 to 2 inches have been driven with the apparatus; (3) perfect and reliable under-reaming below the casing; (4) the method can be worked by hand, steam, or other motive power; (5) the speed obtainable is good, and may exceed 6 meters per hour, 5 meters having even been drilled in that time by hand.—The Automotor Journal.

COAL-WEIGHING AND RECORDING MACHINE.

THE modern practice of storing coal in bunkers at a high level, and allowing the supply to fall by gravitation to the boiler furnaces beneath, affords a good opportunity of applying means to weigh the fuel and obtain a record of the consumption of each boiler. It being understood that the mere measuring of coal is not a true indication of weight, and that in any case it is essential to dispense with manual labor and written records, it is evident that, to be effective, an apparatus should absolutely weigh each load, record the weight, add it to the total, and be entirely free from individual interference. We illustrate an apparatus devised by Mr. Charles Ingrey, of 28 Victoria Street, Westminster, which fulfills these conditions satisfactorily.

The coal is contained in bunkers above, having hopper openings agreeing with the center of the boiler furnaces. Beneath each opening is placed a partially cylindrical receiver which is pivoted in the center, and has an opening at the top and the bottom. This cylinder is capable of being moved upon its pivot to a degree sufficient to close the hopper, whereupon the opening at the bottom of the cylinder is exposed, and causes the contents to be shot into a weigh bucket beneath.

The operation of the apparatus is as follows:

Along the length of the boiler house is a slowly revolving shaft, turning, say, once per minute. Upon the shaft are mounted (in connection with each machine) three cams, which normally are loose, and are retained in position by a loose collar. The end of a sleeve carrying these cams is provided with half a clutch; another half clutch runs upon a feather key on the shaft, and is capable of being operated by a weighted lever, *E* (Fig. 3).

When the lever is worked by the pulling of a cord or rod, *F*, the clutch engages and raises the lever out of a slot formed in a disk attached to the cams, which latter now revolve with the shaft until the slot again presents itself, whereupon the lever falls into it, and the cams are thrown out of gear after making one complete revolution.

The first action of cam No. 1 is to move the pivoted cylinder over to the position shown in Fig. 1, and to deliver the coal to the weigh bucket; the second to restore the cylinder, *G*, to its normal position, where it is filled again ready for the next operation. Cam No. 2 then causes the ends of two supporting girders to descend and to gently lower the weigh bucket on to the knife edges of a weigh beam, and to transmit the absolute weight to the recorder through the medium of a weigh rod which is enshrouded in a tube. The supporting girders are then returned to their upward

position and lift the bucket clear of the knife edges. Cam No. 3 now comes into operation, and by means of a lever and connecting rod opens the hinged door and allows the weighed coal to flow down the chute, *P*, to the boiler furnaces.

The door is retained open for a short period to insure complete delivery, and then descends by its own weight, and closes the spring at the bottom of the weigh bucket. The last operation is (by means of a rod not shown in the elevation) to release the pointer of the recorder, *M*, which then returns to zero, and simultaneously moves the dials of the integrator, which precisely registers the weight, and adds it to the previous total. The cams having completed the one revolution, they are thrown out of gear, and the machine is ready for subsequent use.

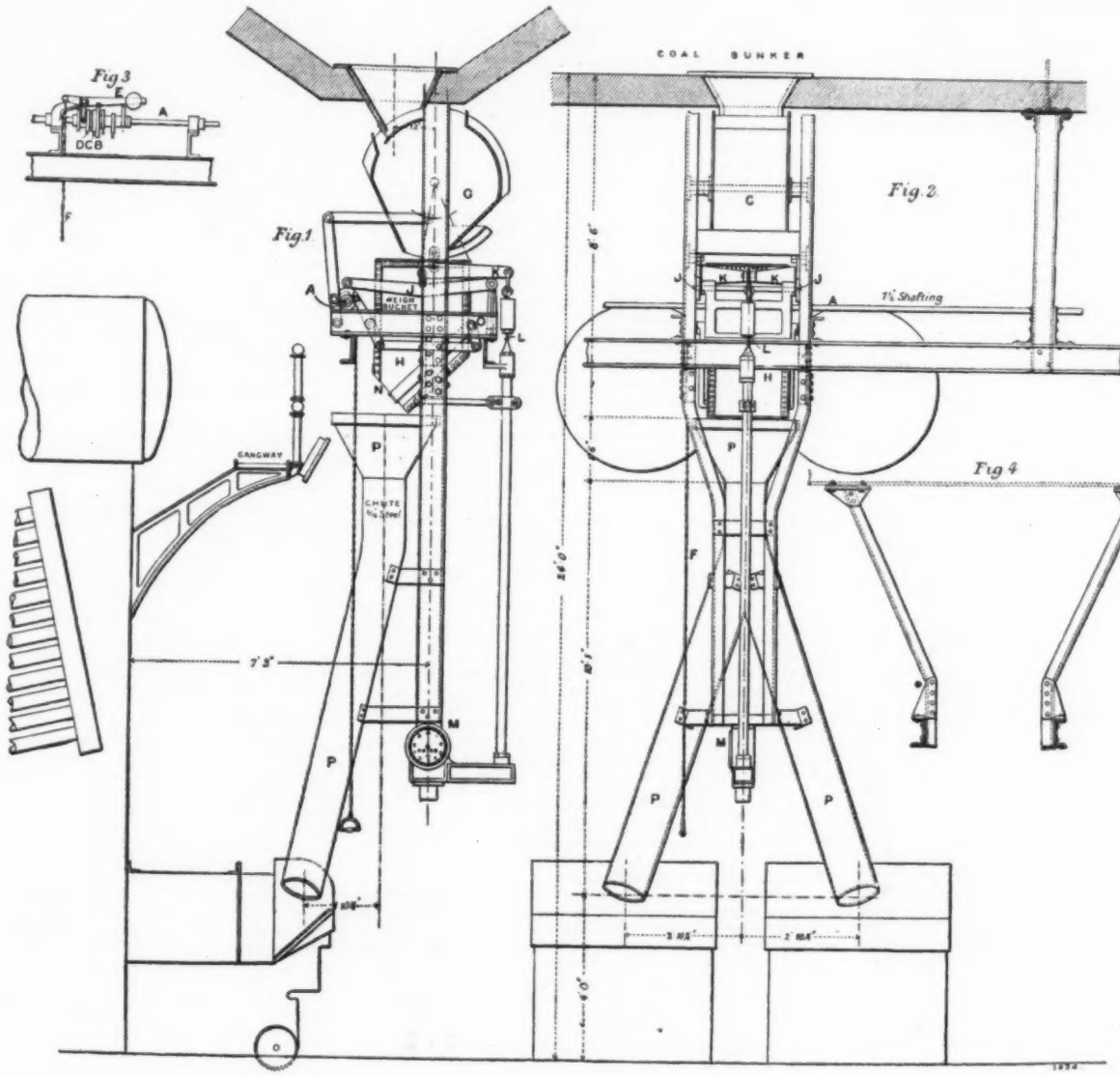
It will be seen that the whole operation is perfectly automatic, all that is necessary on the part of the boiler attendant being to pull the handle on the cord when he sees that the stoker hopper requires replenishing.

It is, of course, generally known that with mechanical stoking considerable waste of fuel can take place if the rate of feed is not attended to. By means of this apparatus the engineer can see at a glance what coal has been consumed, and ascertain whether the boiler or the attendant is doing proper duty.

By means of a pivoted or a breeches shoot, *P P*, each machine can be made to serve two furnaces; but to meet circumstances in which it is not considered desirable to employ a machine for each boiler, Mr. Ingrey has devised a movable machine running upon rails overhead. In this case the revolving shaft is dispensed with, and the necessary motion transmitted by a wire rope or chain, which can also be used to traverse the machine when desired.

The load is approximately 5 hundredweight, which is about the capacity of a stoker hopper.

It should be mentioned that the recorder is hermetically sealed. The only place where dust could enter would be at the mouth of the tube containing the weigh rod, but this is protected by an oiled silk diaphragm which acts as a dust excluder and does not offer any resistance to the weigh rod. It is also to be noticed that the operation of recording the weight takes place after the delivery of the coal and the closing of the door, so that the jarring of the latter does not affect it. The recorder reads to 99.99 tons, or could be made for a greater total if desired. The essential feature of the Ingrey system is the automatic weighing of varying loads in contradistinction to that of accumulating and measuring a predetermined one. —We are indebted to London Engineering for the engraving and description.



INGREY'S AUTOMATIC COAL-WEIGHING AND RECORDING MACHINE.

In a recent issue of Le Genie Civil is published a short note describing a machine for increasing the oxygen content of air before using it in furnaces. The machine is said to be due to M. Mazza, an Italian engineer, and is merely a centrifugal separator. On passing air into this centrifugal machine the oxygen molecules, being heavier than the nitrogen ones, tend, it is stated, to concentrate at the periphery of the machine, and on drawing off the air at this surface it is found to be considerably richer in oxygen than normal air. In fact, the oxygen content can, it is said, be readily brought up to 26 per cent of the total. Common air, it will be remembered, contains but 23.2 parts by weight of oxygen. The centrifugal machine used acts at the same time as a blowing fan, the enriched air being delivered under a slight pressure, while the impoverished air is drawn off continuously from near the center of the machine, says The Engineering and Mining Journal. About 2 horse power are needed, it is stated, to operate a separator capable of delivering 18,000 cubic feet of enriched air per hour. This enriched air has been used for supplying the furnaces of a boiler, and has led, it is stated, to an increase of water evaporated per pound of coal from 9.5 pounds, with natural draft, to over 12 pounds with the Mazza apparatus.

RESULTS OF DR. DOTY'S MOSQUITO CAMPAIGN.

DR. DOTY has issued a report on his experiments in mosquito destruction at Concord, Staten Island. After referring to experiments in various parts of the world which proved that the malarial parasite was transmitted from one person to another by the female of the anopheles species of mosquito, the Health Officer of the port says that he found at least 30 per cent of the inhabitants of Concord suffering from either acute or chronic malaria. "In almost every house or yard were found typical breeding places for mosquitoes," he writes, "either in the shape of used or unused rain barrels, cisterns, cesspools, or abandoned receptacles thrown about the premises. Samples of water from these, as well as all stagnant pools, were examined, and the larvæ found. In some instances, particularly in receptacles about the house, the water was actually alive with them."

Of twenty-seven mosquitoes taken from a bedroom, more than one-half were malarial insects. Examination of a drop of blood from a child afflicted with malaria disclosed the parasite. Tests of many agents for the destruction of the larvæ were made, and it was surprising to find that many deadly poisons were either harmless or slow. Petroleum in any form was rapid and effective, twenty drops in a gallon of water killing all the larvæ within four hours.

The stagnant pools in the Concord district and the weeds surrounding them were treated with oil and relief was felt by the inhabitants. Mosquitoes, Dr. Doty finds, prefer to remain close to their breeding places, where they take shelter during the day in the weeds and long grass. The remedy must be drainage of stagnant pools and other breeding places, conducted by officers under a system of co-operation of municipal, state, and federal authorities. Suggestions that birds and dragon-flies should be propagated for the destruction of mosquitoes, he says, are not entitled to serious consideration.

Dr. Doty summarizes his work as follows: First, it has shown the intimate relation between the mosquito and malarial fever; second, it has revealed the true breeding places of the mosquito, not generally known; third, it has shown that petroleum oil will surely and promptly destroy mosquito larvæ and, so far as careful experiments indicate, it is the only agent which can be depended upon for that purpose.—New York Evening Post.

FRUIT IN THE ASSUAGEMENT OF THIRST.

CHEMICAL analysis would assign practically no nutritive value to the juicy fruits, for they consist of little more than a cellulose envelope containing a solution of sugar, the amount varying from 17 per cent, as with grapes, to about 1.4 per cent, as with lemons. The amount of water in fruit is considerable. In watermelons it is no less than 95 per cent, in grapes 80 per cent, in oranges 86 per cent, in lemons 90 per cent, in peaches 88 per cent, in apples 82 per cent, in pears 84 per cent, in plums 80 per cent, in nectarines 83 per cent, and in strawberries 90 per cent, not a fruit in the whole category containing less than 80 per cent. The irresistible conclusion, considering these facts, is that fruit plays an important rôle in diet as a thirst quencher. Certainly when fruits are freely represented in the diet less fluid requires to be consumed and fruits would appear to be endowed with a subtle inimitable flavor which is ample inducement to imbibe fluid in this most wholesome form. The question so prominent in people's thoughts at the hot season of the year as to what to drink might, therefore, on sound physiological reasoning, be answered, eat sound, ripe, juicy fruit. It is noticeable that as fruit enters into the diet the indulgence in alcoholic drinks is diminished. Thus it is most satisfactory to observe people taking a good juicy slice of melon as preparatory to a meal instead of sherry and bitters or a "cocktail." This is a most commendable practice and the proceeding is dietetically speaking perfectly rational. The flavorings of fruits, although of little nutritive value, are undoubted stimulants to the appetite and aids to digestion. Moreover, the juice of fresh cut fruit is perfectly free from microbes, is as sterile as freshly clean-drawn milk, and the fruit acids tend to inhibit the power of those disease-producing bacteria which flourish in neutral or alkaline media. The marked anti-scorbutic properties of fresh fruit due to the vegetable acids and their salts in the juice are of great importance. For the most part these acids are combined with potash and hence a free diet of fruit preserves a healthy alkaline condition of the blood and there is consequently a reduced tendency to the depositing of

acids in the tissues. Peaches and that delicious and delicately flavored fruit the nectarine contain quite a small quantity of sugar, and this, coupled with the fact of the tenderness of their pulp, makes them suitable for the gouty and diabetic. There can be no doubt that the juice of sound ripe fruit is an ideal means of assuaging the intense thirst of hot weather —cooling, refreshing, and of an agreeable flavor. It is a common experience that the more a person drinks to satisfy the demands of thirst in hot weather the worse he feels. The temptation is to gulp down huge quantities of fluid with the result that excessive perspiration sets in and a very uncomfortable and unrelieved feeling follows. On the other hand, a judicious amount of sound, ripe, juicy fruit, while containing all the water necessary to assuage thirst, would lead to no such distress and would exercise other healthy effects on the bodily functions.—The Lancet.

[Continued from Supplement, No. 1344, page 21548.]

METHODS OF CURING TOBACCO.*

By Milton Whitney, Chief of Division of Soils.

CURING BRIGHT YELLOW TOBACCO.

The tobacco grown in Maryland and on the heavier soils of Virginia and North Carolina is used both for manufacturing purposes and for the regie trade. Tobacco has been a staple article of produce in Virginia and Maryland since the very earliest colonial times, and it forms a very interesting part of the history of the development of the two States. Large quantities were formerly sent to France, Holland, and Belgium, and it was highly thought of for pipe smoking in our domestic trade, it being a bright, mild, and sweet-flavored tobacco. In recent years, however, the White Burley has been coming into great favor for the same purpose that the Maryland and Virginia tobaccos were formerly used for. The very much larger yield of the White Burley has lowered the price of the Maryland and Virginia tobaccos almost below the point of profitable production.

The process of curing these tobaccos is essentially the same as that just described for the White Burley. There are, however, certain districts, especially in Virginia, where certain modified methods have been used to such an extent as to give character to the tobacco. But these are local methods, and are not as prominently recognized now as they were a few years ago.

The bright yellow tobacco of southern Virginia, North and South Carolina, and East Tennessee, is grown upon a certain type of very sandy soil. The planting is usually done from the 10th of May to the 10th of June. The plant is topped to from eight to twelve leaves, depending upon the vigor of the plant and the character of the season. The more vigorous the plant and the wetter the season, the more leaves can be left on to mature. The plant is regularly suckered every week if need be. There are various methods of harvesting the crop. Sometimes the entire stalk is cut, as with other tobaccos, usually only those which appear to be ripe being taken and the others being left to mature further. At other times the leaves are picked off as they mature and the rest of the plant is allowed to ripen further.

The second method has a decided advantage from the fact that the leaves of a plant do not all ripen at the same time. There is less waste and the leaves are gathered at about the same stage of maturity. The plant should be thoroughly ripe when cut in order to give the finest texture and the brightest color. If the whole plant is cut, it is speared onto a stick, or, if the leaves only are stripped as they ripen, they are strung on a string or wire and attached to a lath. The leaves are sorted to a certain extent in the field, keeping those of a uniform color and ripeness together as much as possible. When cut, the tobacco is carried at once to the barn without exposure to the sun and without allowing it to wilt or to lie upon the ground.

The tobacco barns are tight, with flues running across a short distance from the ground and returning to the chimney, which is built next to the furnace. In early days barns were built of logs, with the cracks completely stopped with mud or clay so as to make them perfectly tight. The barns are usually small, averaging from 16 to 22 feet square and of about the same height to the plate. Frequently as many as 18 or 20 of these barns are built together on a plantation, but never closer than about 100 feet apart, on account of the great danger from fire. There are quite a number of different barns and of different flues and of arrangements for distributing the heat, many of them patented and all of them described with more or less minuteness in tobacco literature.

The tobacco is hung in the barn in as fresh a state as possible, and the firing immediately begins, so that the heat will ascend into the tobacco while the leaves are stiff and the heat can be equally distributed throughout the space. Three days are needed to cure a barn, and it takes from two to three cords of dry wood. It requires very careful judgment and careful observation to cure this bright tobacco properly. The least inattention or wrong move is liable to reduce a barn of the finest yellow tobacco to a very inferior grade. No definite rules can be given, but the information must be acquired through experience, preferably under the direction of some person who has acquired skill in the method.

When the fires are started, a thermometer is hung on a level with the bottom leaves and is carefully watched day and night, while at the same time the plants themselves are carefully and frequently inspected. The heat must be increased very gradually, but it must never on any account be checked. It must never be so intense as to cause sweating. The first process in the curing is to maintain a temperature of 80 degrees or 90 degrees until the leaf is yellowed properly. This requires from eighteen to thirty-six hours, and must be very carefully managed. After the yellowing the heat is raised 5 degrees or 10 degrees at a time, and held at each stage for one or two hours, until it has attained a temperature of 115 degrees or 120 degrees, where it is held for several hours until the leaf is thoroughly cured. After this the stalk has to be cured by raising the temperature to 160 degrees or 175 degrees, by stages of 5 degrees or 10 degrees per hour, and keeping the temperature at this point until the stalk is thoroughly cured.

After the drying the barn is opened and the fires go out, and after thirty-six hours the leaf is usually in order for removal. It should not be exposed to very damp weather, as this is supposed to injure the color; but if the air outside is too dry, a little wet straw may be thrown over the flues in order to slightly moisten the atmosphere of the barn. The tobacco is then taken down and bulked on the sticks in piles. It is left in this way for several days to straighten out the leaves and improve the appearance. It is then rehung, being crowded very close to prevent injury as far as possible from atmospheric changes, or it may be bulked down permanently to keep it in order for stripping.

The leaves are stripped from the stem and tied into hands after being sorted into six or eight grades of wrappers, fillers, and smokers. The tobacco is then bulked down and left for one or two months, when the color becomes fixed and the slight greenish tinge which was left on removal from the barn is removed. The color is then no longer subject to change. Much of the tobacco is carried loose to the warehouse and sold in the open market. Some of it is packed in small hogsheads and shipped.

It is very necessary to grade the tobacco properly according to the character of the leaf and its color.

CURING EXPORT TOBACCO.

The class of tobacco known as dark export or shipping tobacco has a strong, heavy leaf, used largely in the export trade. It is exported in great quantities to England and the other continental markets of Europe, as well as to Africa and other foreign countries. In Europe the tobacco is used for cigars, chewing, and smoking, but its chief demand is as wrapper leaf. In our market it is graded according to color, fatness, texture, and length of leaf, each foreign country buying essentially a particular grade.

In the dark (export) tobacco districts when the leaves are ripe the stalk is cut and laid on the ground to wilt. It is then put on sticks, six or eight to the stick, and hauled to the barn. The tobacco is either hung immediately in the barn or is hung on scaffolds outside for a few days to yellow. There is a difference of opinion as to whether this yellowing process goes on better on the scaffolds or in the barn. In either case it acquires in a few days a rich, deep yellow color. When the leaves show an even yellow color, slow fires are built on the floor of the barn, very small at first and gradually increasing in size until the barn becomes as hot as it is safe to make it. This firing process requires usually four or five days. It is important that the wood should be thoroughly seasoned in order not to produce smoke. Smoke makes the tobacco bitter and leaves an odor of creosote on the leaf. This heating cures the leaf, but leaves the stem still green. After the fires are withdrawn the sap runs down from the stalk into the leaf and in the event of damp weather a second or third firing is frequently given by the best growers. Flue curing has not been practised with any general success so far in the dark-tobacco region.

After the tobacco is properly cured, the leaves are stripped from the stalk, graded as to length and quality, tied into hands, and bulked down in piles four or five feet high and covered with canvas or loose boards. Fermentation undoubtedly occurs while in the bulk, but to what extent and exactly what changes are produced are not known. Little attention is paid to the matter except to see that the temperature of the bulk does not at any time rise too high. The tobacco is either sold loose or prized into hogsheads, as with the White Burley and manufacturing tobaccos.

TYPES OF EXPORT TOBACCO.

The dark tobaccos are classed into four general types, which are further graded according to color, the darkest first, viz.: 1, German type; 2, Italian type; 3, Austrian type; 4, French type.

1. The German type is a very fat, heavy-bodied leaf, strong, tough, and elastic, 18 to 26 inches long, with fine stems and fiber. Generally the heaviest, darkest types go to Germany, the color varying according to the demand, but a fat leaf is always required. Length is not a prime requisite, but is an advantage.

German Saucer is a piebald leaf, sweet, strong, and elastic, with other characteristics of the general German type. It is used in the manufacture of plug, and is called "Saucer" on account of its treatment with certain liquors or sauces before manufacture.

German Spinner is rich and heavy (heaviest of all the dark tobaccos), of clear, fine texture, very elastic, of darkest color, and is used in spinning twist tobacco.

2. The Italian type is a little lighter in color than the German types, very smooth and silky, not so fat, but of good length. They are sorted into three grades: A, B, and C. A is a leaf 25 to 26 inches long, of delicate fiber, solid red-brown color, elastic and strong, and is used as a cigar wrapper; B, 22 to 25 inches long, is used for cigars and snuff, rich and of good body; C, 18 to 20 inches long, is used for cigars, moderate weight of body, yet in other respects corresponding to the type A.

3. The Austrian type is slightly lighter in color than the Italian, but the two types grade into each other so that no sharp line can be drawn. They are very smooth, fine in fiber, very solid, firm, glossy, red-brown, tough, elastic, and of good length.

Under the Austrian wrapper may be classed the Swiss wrappers, by many called the finest type of dark tobacco. Swiss wrappers are from 26 to 30 inches long, broad, silky, of fine fiber and stem, chestnut-brown in color, wide between fibers. They are used in Switzerland as cigar wrappers. The amount of wrapper shipped to Switzerland is small, but it brings the highest prices.

4. The French type of tobacco is lighter in color, a brownish-red to red; thinner of body, not so fat; has little elasticity, and is in most ways a poorer grade of leaf than the three types just described. A clear leaf, supple and even, is insisted upon. France also takes some heavier tobaccos, according to demands. The grades are: A, 23 to 25 inches long, moderately smooth, good color, dark or light according to use; B, 18 to 22 inches long; C, good lugs.

The Spanish regie trade takes a large quantity of nondescript and low-grade leaf and lugs of all types, colors, and textures. Very little good leaf is called for.

The English type conforms in nearly every respect to the German demands, one type filling both markets. The English government imposes a tax on all imported tobacco; hence, weight is reduced in every way possible before tobacco is shipped to England. Much of it is stemmed, the midrib is cut out, the leaves are tied into hands and hung up in open, well-ventilated warehouses. The leaf is bulked in as dry order as possible, with only enough moisture so that the leaf will not break when handled.

The heaviest type of tobacco goes to England for use in navy plug. Sailors require stimulants, and the heaviest of tobaccos carrying a high percentage of nicotine are used in navy plug.

CURING PERIQUE TOBACCO.

The variety of tobacco known as Perique, and valued and famed throughout the markets of the world for its fine flavor and aroma, is all raised within the Mississippi bottom-lands, mainly in St. James and Assumption parishes, La. Fifty thousand pounds is probably the largest crop ever raised of this tobacco, and, considering the ready market and high price it brings and the ease with which it can be raised, it seems strange that its cultivation and curing has not extended. At present the culture and peculiar methods of curing are only practised by the Acadians living close by the Mississippi and upon the Grand Pointe Vacherie. A vacherie is an island raised four or five feet above the swamps bordering the river. Dr. Stubbs, director of the Louisiana Experiment Station, gives the following description of the peculiar method of curing this tobacco:

The soil of the vacherie is a calcareous loam of a chocolate color, of great fertility, and easily worked. This soil is preferred to the sandy river soil.

True Perique is a fine fiber, medium leaf, and small stems; is strong, rich, gummy, tough, and dark, and when taken from the press has a beautiful, glossy appearance. On account of its strength it is mixed with milder kinds, both for smoking tobacco and cigarettes. By Louisianians it is also chewed. There is a material variation in the quality of leaf grown. On a sandy soil it has a delightful aroma, highly prized, which declines with the increase of clay in the soil. The crop is graded into wrappers, fillers, and smokers. At one time every leaf was brushed and cleaned before being subjected to curing. This is not now generally done.

The tobacco will show a yellowish, mottled appearance, with leaves crisp and easily broken, about the 1st of July, when it is ready to cut. Contrary to the general practice elsewhere the plants are cut during the hottest part of the day, three inches from the ground, leaving two or three leaves on the stump which are regarded as worthless, having served their purpose of protecting the rest of the plant from sand and dirt. Sharp-pointed pieces of swamp cane are stuck in the end of each stalk, making a hook, by which each plant is suspended upon a rope stretched lengthwise in the shed, the plants 6 inches apart on the rope, the ropes 1 foot apart. As the plants wilt and the leaves become brown they are removed from the stalk, and the midrib, still green, is taken out. The first leaves are pulled from the stalk in about ten days, and one to three leaves, at intervals of a few days thereafter, until the stalk is stripped.

The leaves, after the removal of the midrib, are twisted into rolls of 20 to 30 leaves each. These rolls or twists are packed into boxes 11 inches square, holding about 50 pounds, and when the boxes are nearly full are subjected to a continuous pressure of about 7,000 pounds per square foot by means of weights on a lever 12 to 15 feet long. The pressure must be continuous, therefore screw pressures can not be used. After being under pressure for twenty-four hours, the tobacco is taken out, opened, and aired a few minutes until the exuded juices, black, tarry, and thick, can be reabsorbed, when it is again subjected to pressure. This treatment continues daily for ten days, every twist being opened, aired, and turned so that the juices will saturate the entire mass. From a light brown the tobacco grows darker each day until it shines in oily blackness. After ten days the manipulation becomes less frequent, say once in three or four days.

In three months the tobacco is cured and emits a rich, spirituous flavor which has been imparted to it by the reabsorption of the oxidized juices. It will thus be seen that Perique tobacco is cured and preserved by the resinous gums contained in the natural leaf. The wrappers are handled with great care and kept separate during the process of curing.

The tobacco is next put into cylindrical rolls, or "carottes," containing 4 pounds usually. The leaves are opened, straightened, and aired. Upon a cloth 24 by 15 inches the best wrapper leaves are placed, bottom side down, and the fibers so arranged as to point to a longitudinal median line. Leaves to the depth of half an inch are placed on these, and over them a second cloth, and this mass tramped. The ends of the mats are then doubled over about 3 inches and the whole tramped again. The entire mass is then rolled into a cylinder and the corners of the leaves tucked down into the hollow center. The ends of the cloth are tied and a rope wound tightly around the coil from end to end by a windlass made for the purpose. At the expiration of twenty-four hours the rope is taken off and rewound very tightly. After this the carotte is ready for the market. An ordinary man, with a boy, can put up ten carottes a day.

MARKETING TOBACCO.

For the production of a salable article much depends upon the character of the soil, and a great deal depends upon the skill in curing. Fully as much, however, depends upon the proper grading and sorting of the tobacco, and the style of package in which it is sent to the manufacturer. Too much cannot be said about the necessity for very careful attention to these

* Farmers' Bulletin No. 60, U. S. Department of Agriculture.

apparently small details. It is very important, moreover, that the planters should study the markets, the demands from foreign countries, the requirements of our own manufacturers, and aim to produce exactly what they want, and to get it to them in the way in which they can best use it rather than to study the matter of economy.

A great deal can be accomplished by improving the seed, by importing new seed and by improving the methods of cultivation, but more can be accomplished by a steady and persistent effort to produce, through methods of cultivation and fermentation, sorting, grading, etc., the closest possible resemblance to the type which is desired by the manufacturer and the consumer. This is the business side of the transaction. A careful study of and compliance with the requirements of the market undoubtedly will insure a better price quite as much as any difference in the smoking and chewing qualities of the leaf. The excellence of tobacco in these qualities has improved much more than the practice of grading and sorting in compliance with the market demands. There is yet plenty of room for improvement in the quality of tobacco, but just at present the chief need is for additional attention to these commercial details.

A REMNANT OF BUDDHA'S BODY.

IT is possible that in India we are allowing an opportunity to slip through our fingers.

In the summer of 1900 a mission, under the Lama Derzbieff, little noticed at the time, but conspicuously contrary to the traditions of the race that it represented, was sent by the Buddhist community of Usga, in Mongolia, to St. Petersburg. The Telai Lama, the religious head of the district, has, as a speedy result of this expedition, granted to the Russians concessions of territory or rights of way (the distinction is probably not recognized by the beneficiaries) in northern Mongolia along the 48th parallel of north latitude, for the apparent purpose of doubling the transcontinental line from Petuna or Kirin Junction to Omsk by a track running south of the Sayansk and Yablonoi ranges.

The importance of this mission was two-fold; it lay partly in the fact—and Russian diplomacy is not slow to note such a point—that the Telai Lama has no real right whatever to issue such grants.

There can be no doubt that the worthlessness of the title will cause disturbance in the districts affected, and probably also at the seat of Chinese government, while the fact of any concession, however invalid, having been made will be sufficient to satisfy the small needs for excuse that Russia has been accustomed to consider necessary whenever an advance has to be made or a few thousand square miles added to her Asiatic possessions.

But even greater importance must be attached to this successful attempt to open up communications with the Lamaic hierarchy of China, in view of the fact—suspected from the first and now known to be true—that the action of the Telai Lama was sanctioned and probably suggested by the head of his religion, the Dalai or Grand Lama of Tibet. We are reminded of our own relations with that vastly more powerful potentate, and the unpleasant necessity of anticipating Russian influence in a state touching our northeastern frontier of India is brought home to us by the presence in St. Petersburg at this moment of a formal embassy from Lhasa itself.*

For our own failure to communicate with Lhasa the reasons are two-fold. The British have hitherto wrongly regarded Tibet as a dependent state of which the foreign relations were wholly in the hands of the suzerain power, China, though, in defense of this attitude, it is but just to say that the Tibetans themselves, in their wish to protect their isolation, have repeatedly met Indian advances by the plea that they had no power to enter into diplomatic relations with their southern neighbors. It is, on the other hand, useless for us to endeavor to communicate with the Tibetans through the medium of the Chinese, who for some eight years have been refused all allegiance, and whose tribute money has remained unpaid for the same, or a longer time.†

But an even stronger barrier to our progress has been imposed by Kwei-Chun, the present Viceroy of Szu-Chuan, through whose hands all the trade of Tibet, except the little that is secured by Nepaul, now passes, and for whom this practical monopoly is a constant and increasing source of personal enrichment.

It is clearly to his interest to close the alternative and shorter trade route to and through India by Sikkim or Assam, and he has hitherto cordially co-operated with the Dalai Lama in his policy of isolation—possibly even to the extent of silently acquiescing in the independence of the kingdom of Tibet, which is nominally tributary to his own province. He is now, for some reason that cannot be only the fact that, although of Manchu nationality, he is a supporter of the policy of the Yangtse Viceroys, under the gravest displeasure of the Empress Dowager, and though it is a matter of the merest conjecture, it is possible that he has acted as counselor to the Tibetans at the present juncture, on the ancient principle of the unjust steward.

In any case, Lamaism has gone some way toward a recognition of the advantages of Russian alliance to the exclusion of England, and the matter is not one of small importance.

To obtain a grievance is, with Russia, often equivalent to obtaining a province, and the claims of the Muscovite may, though only in the distant future, become a matter of grave embarrassment to us if, as seems likely, the authorities in China attempt to repudiate the acts of the Telai Lama and his chief.

It is obviously bad policy to increase, even by one, the number of "points of anxiety" in the empire, and if it should prove possible at the present time to make of Tibet a substantial buffer state by a timely act of diplomacy, the wisdom of taking such a step is clear.

But it will be urged that we have repeatedly attempted to break down the barrier that has been erected by the Tibetans against us, and that on every occasion the olive branch has been persistently and even rudely rejected.

This is, of course, true, and it is to be remembered that the attempts of private individuals to enter the Forbidden Land against the expressed wishes of the Dalai Lama have certainly in no way helped Indian diplomacy. The Tibetan is quite unlikely to distinguish between the enterprise or the bravado of an unofficial Englishman and a systematic espionage on behalf of the Viceroy's government; nor is there any reason to suppose that the vigorous prohibition which the latter now imposes upon all attempts to cross the frontier from our own side is accepted in Lhasa as a proof of good faith.

It is, however, some time since an Englishman has been forcibly put across the frontier of Tibet, and the experiences of the Buddhist envoys to St. Petersburg may not have been without use in making even the lord of Potala palace realize that the days in which mere isolation is an adequate defense are over. It is true that the argument which induced Joshua to make peace with the wily Hivites is still likely to be a strong inducement to the Oriental mind; but it will not be the first time that we have been compelled, for our own safety—and theirs—to instruct neighboring potentates in the elementary needs of national existence at the present day; and if the possibilities to which I have alluded are to assume hereafter even a vague shape, it will then be a matter for sincere regret that advantage was not taken of one of the golden opportunities that the standing luck of the British Empire seems always to drop into the hands of an embarrassed cabinet in London.

There was recently found at Bhattiprolu, in the Kistna district of the Madras Presidency, a relic that is accepted by experts to be, on the whole, the most authentic remnant of Buddha that is still extant.*

This relic the late governor of Madras proposed, somewhat hastily, to hand over to the King of Siam, who, since the overthrow of Thibaw, has come to be regarded as the sole independent sovereign of a professedly Buddhist race, and the Siamese government was given notice of his intention.

In making this offer he was not unsupported by precedent, but in the opinion of high Indian authorities he had himself no power to make any promise that involved the loss to the empire of any "object of high archæological importance." The Viceroy himself would probably require the assent of the Secretary of State for India before making any such gift, and in the case of Sir Arthur Havelock the fact that he was acting *ultra vires*, and therefore cannot be held to have bound the home authorities, seems to be admitted.

It would seem that the claims of the Emperor of India—who, it must not be forgotten, is also King of Burmah and Ceylon—are *ex hypothesi* greater than those of even the sovereign of the only Buddhist state yet remaining, and there should always be deep consideration before we part with any relic that would serve to increase the respect of the natives for, and the religious importance of, our rule in India. It would, indeed, be a new departure to ignore the great importance of the respectful impartiality with which we have hitherto been relied upon by the natives to treat every religious scruple or prejudice in India.

The story of the finding of the bone, which is a small flake about the size of a finger-nail‡—probably taken from the head of the femur—is of some little interest.

Discovery was first made at Bhattiprolu of a great granite ball, nine or ten feet in circumference, bearing traces of heavy gilding. Extreme importance was attached to this find by the fact that an inscription in clear Asokan characters was discovered cut on the inner surface of the bisection, by which the mass fell apart upon the application of pressure. This inscription stated, among other data that prove the identity and intention of the original preservers, that the Bone of the Master lay within. In the center of the outer ball, in a carefully-hollowed recess, a second and much smaller one, about 6 inches in diameter and 9 in height, was found, and this in turn opened and disclosed a small clear transparent box of pure white crystal, circular in shape and about 2½ inches in diameter, wherein the precious morsel lay.

The date of the writing (250 B.C.) carries us back to the days of the council at Pataliputra or Patna, and to within 150 years—according to Prof. Rhys Davids—of the death of Gautama, and is, in fact, contemporaneous with the earliest records yet accessible to us, which, however unreliable in some respects from the overgrowth of miraculous accretions, state definitely that, by his own wish, parts of Buddha's body were distributed after his death among the faithful.

The strength and costliness of the protecting encasings, and the district in which it was found, seem to lend additional importance to the relic; but it is of no profit to ourselves to investigate further the mere authenticity of this slight scale of bone, still as white and clean as on the day of its entombment.‡

It is enough for us to know that in the eyes of the Buddhist hierarchy it is admitted to be a treasure of the utmost religious importance, and even were there no obvious use for the bone at the present moment, it would seem a mistake to surrender it to the Siamese without a *quid pro quo*.

It would be difficult to estimate whether the Emperor of India, the Emperor of Corea, the Emperor of China, the Emperor of Japan, or the King of Tibet has under his sway the largest number of Buddhists; but it is probable that the subjects of the King of Siam are completely outnumbered by even the least of the four sovereigns mentioned, and for the sake of Burmah and Ceylon alone we should not idly throw away something that makes for the importance of the British Raj.

Such, at least, seems to have been the Viceroy's opinion. Lord Curzon, on the facts being laid before him in Madras by Mr. Thurston, the keeper of the museum, was naturally anxious to retain the relic which Sir Arthur Havelock had, without sufficient authority, apparently undertaken to present to the Siamese, and vetoed any further steps until the opinion of the Home Government had been ascertained.

So far the matter is hung up, but it cannot be urged too strongly that, if the government of India decide to part at all with the bone, there is a strong case, indeed, to be made out for giving it to an entirely different people.

To open negotiations with Tibet is a matter that will become a necessity to-morrow, if not to-day, and it seems but too likely that, if delayed long, it may ultimately take the form of armed intervention with a state under the quasi protection of Russia's sphere of interest.

The position of the Dalai Lama himself is to be noted.

I suppose that the ruler of the Forbidden City is most often characterized in the European mind as a saturnine despot. As a matter of fact, he is chosen within a month of his birth, is rarely allowed to survive his twentieth year, and is helpless in the hands of his curia of abbots and priests. The King of Tibet usually suffers the same fate, and, like the Chinese resident, who ranks third in the scale of precedence, is politically insignificant.*

In many ways the close similarity of the form of Buddhism that obtains in Tibet with the Roman Catholicism of the present day is remarkable; but in no matter is it more conspicuous than in the fact that a body of counselors, nominally subordinate, has the entire actual authority, nor does the preference of the Roman body for a figurehead rendered harmless by extreme age make their policy essentially different from that of the Lhasan chutuktus, who choose to secure the same end by the elevation to the purple of a child who is not allowed to survive his maturity.

The best-laid plans may fail, and it is curious that both the present Pope and the present Grand Lama are, in different degrees, exceptions to the general rule. The latter, who attained manhood ten or fifteen years ago, is reported to be an able man, and seems to have somewhat more power than has been usually possessed by his predecessors.

But for him and his council there are the defects of their qualities. Basing their authority exclusively upon their religious ascendency, it would be practically impossible for them to refuse to receive a deputation from the Viceroy which came to offer to the Grand Lama the relic that has just been discovered in Southern India, and it would wholly depend upon the composition and the powers of that deputation whether the foothold thus secured could be made of any real use for the preservation of the independence and—with certain guarantees, of course—the continued isolation of Tibet. All things being considered, the trade we might acquire by opening the markets of the country is not sufficient in itself to outweigh the obvious advantages of possessing in Tibet a buffer state of the most perfect impassability.

We have looked with unconcern upon the increasing isolation of Nepaul. Here, where twenty years ago the British officer who could get two months' leave was sure of a tolerable welcome and excellent sport, the spirit of reserve has been allowed to grow till, with the exception of the valley in which Khatmandu lies and the straight highroad thence to the frontier, there is no part of Nepaul which is not as jealously guarded as Tibet, and from this interdict the English resident himself is not exempted.

With this we need have no quarrel. But it is essential, both for Tibet and ourselves, that we should have a friendly understanding with the rulers of this extraordinary country, and it seems that we have now offered to us a key to the city of the avatars that is not only cheap and effective, but has appeared at the psychological moment for its use.

If the matter be pressed forward, the ease with which it can be accomplished is as striking as the coincidence of its appearance.

The Crown Prince (Kumar), the second son of the Rajah of Sikkim, our farthest post on the road from India, is officially regarded by the Dalai Lama as a present reincarnation of Buddha, possibly even as *the* reincarnation of Gautama himself, and the cordial relations that exist between him and the British government and the perfect appreciation of his father of the necessities of the case will enable us, through the Rajah's eldest son, who embraced the religious life and is now a lama of high rank in Lhasa, to approach without difficulty and without incurring unjust suspicion, the central authorities of Tibet, whose very existence may depend upon their co-operation with ourselves in safeguarding the last available avenue that leads into our Indian dominions.—Perceval Landon, in the Nineteenth Century; reprinted by permission of the Leonard Scott Publication Company, New York.

An electric arc can be used under water for fusing metals. It is thought that with proper apparatus divers could cut through quickly large cables and iron plates of vessels.

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* There are one or two points to be noted in connection with this embassy. It seems that the Russian press has lately gone too far in jubilation over the opening up of communication with Tibet; it was never intended that the far-reaching results that may flow from the presence of the envoys in St. Petersburg should be as widely advertised as has actually been done in the Russian newspapers. Consequently a somewhat awkwardly worded "inspiration" has appeared in the Vledomosti, which assures its readers, with true Muscovite insensibility to humor, that the envoys have arrived for the purpose of protesting against the undue importance that has been attached to their arrival.

It is difficult to disentangle the facts of their journey and their intentions from the garbled and conflicting accounts that have been published. It is unique, however, that the members of the embassy made their way through India or in disguise; it seems probable that they came through Bhamo and Rangoon to Colombo, where they waited till they were picked up by the "Tamboff," a ship of the Russian Volunteer Squadron, which put in for a day on her way to Odessa. It is, however, clear that the formality of their reception, not by the ministry only, but also by the Czar himself, disposes finally of any assertion of the unofficial character of their mission. Too much importance need not be attached to the permanence of any agreement that may be arrived at. The Oriental rarely refuses to consider a higher bid, even after the hammer has fallen.

† Since 1890, according to a statement in a recent issue of the Daily Mail.

* It is to be distinguished carefully from the somewhat unsatisfactory discovery of the reputed tomb of Buddha in Northern India several months previously.

† There is thus ample material to make two satisfactory relics in case it should be found to be impossible to refuse some part of the relic to the King of Siam. The legendary three hairs of Buddha that lie beneath the Shwe Dagon in Rangoon—the St. Peter's of the Buddhist faith—are a slighter foundation on which to build than even a quarter of this Indian treasure.

‡ It is, however, permissible to point out, as a matter of archæological interest, that the iron crown of Lombardy, which is generally supposed to embody that Christian relic which possesses the greatest amount of evidence acceptable to modern research, cannot prove its pedigree to within so near a date to that of the death of the founder of the faith in question.

* The Pantshen Lama, who possesses high religious importance, ranks only as a chutuktu, or cardinal. Nothing, by the way, is so expressive of the distance that modern Lamaism has traveled from the austere simplicity of Buddha's own doctrine as the fact that all members of the college of chutuktus are regarded as having ex officio attained Bodhisatship.

THE FIRST SUBMARINE BOAT.

The really practical experiments in submarine navigation date back to the beginning of the last century, and gave surprising results from the very start.

It was just a century ago (May, 1801) that the Parisians saw evoluting upon the Seine, near the Invalides, a strange boat of abnormal form that not only navigated upon the surface, but dived at one place and made its appearance again either up or down stream. This was the first submarine boat, the "Nautilus," devised by the American engineer, Fulton.

The history of this little boat, which contained the germs of every element that has since been improved in order to arrive at our present submarine craft, is very curious; and so we have thought that it would be of interest to recall it, and the more so in that it is but little known. The name of Fulton, moreover, brings to memory one of the greatest industrial progresses made at the beginning of the last century, the application of the steam engine to navigation.

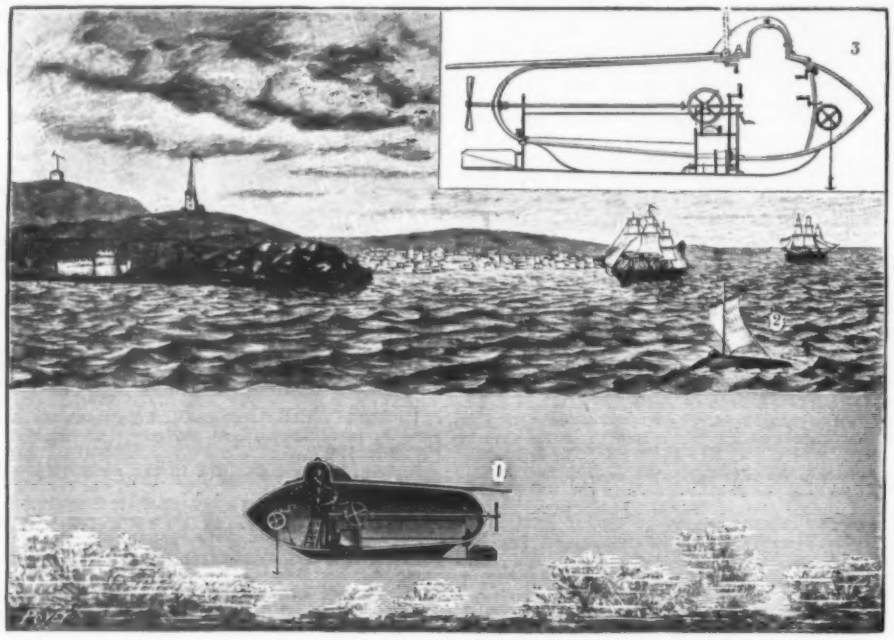


FIG. 1.—THE "NAUTILUS," THE FIRST SUBMARINE BOAT, EVOLUTING IN THE ROADSTEAD OF BREST.

1. The boat navigating beneath the surface. 2. The boat navigating on the surface through a sail. 3. Section of the "Nautilus."

Fulton, the son of Irish immigrants, was born in Pennsylvania in 1765. He devoted himself in the first place to drawing and painting, and in order to perfect himself in his art, went to England. Here he soon became intimate with some engineers, and relinquished his pencils in order to study mechanics. He then made himself known by various inventions, and, having become a civil engineer in 1796, occupied himself more particularly with canal work. His object in visiting France was to propose a system of inclined planes as a substitute for lock chambers—a system for which he had obtained a patent in England. After reaching Paris, he became intimate with some of the scientists of the Institute and some civil and military engineers and thus greatly enlarged the scope of his ideas. He published various studies, and, aside from his mechanical labors, executed the first panoramic picture that had been exhibited in France and that proved a great success.

Being a partisan of the ideas of the French Revolution, he began to seek a means of assuring the liberty of the seas in order thus to conduce toward the happiness of nations. To this effect he desired to strike the maritime power of England, which at that time was everywhere exercising a true tyranny. This consideration suggested to him the first idea of his system of "Submarine Navigation and Explosion," which was put in practice by the creation of the torpedo and the submarine boat, with which he wished to provide France in order that it might do battle with England.

In 1797, he made upon the Seine some experiments in submarine explosion produced by a species of bomb carried by a small dirigible boat and called a "torpedo." The direction once given, the motion of the torpedo was effected by a clockwork mechanism, and, by means of a long cord, a trigger was pulled so as to ignite the powder at the desired moment.

In the interim, he devised a sort of closed boat designed to navigate beneath the surface in order to surprise and blow up the vessels of enemies cruising along the coast. This was the "Nautilus," the first submarine boat.

Fulton had in the first place submitted the plans of his submarine boat to the French government, which appointed a committee to examine them; but, despite a favorable report, the Minister of War showed himself hostile to the innovation. The inventor did not lose courage, but constructed a small model of his boat and asked aid and protection from Bonaparte, who had become consul. The latter commissioned Volney, Laplace and Monge to make a report to him upon the invention. The impression was favorable and so the sum of 10,000 francs was granted to Fulton in order to permit him to pursue his experiments.

In May, 1801, Fulton performed some interesting experiments in submarine navigation upon the Seine in his "Nautilus." He navigated upon the surface and dived and remained under water, in running with or against the current, for thirty minutes. Only one man accompanied him. A candle illuminated the interior of the boat during the maneuvering, which was effected without any trouble. This experiment demonstrated the possibility of living during a lengthy immersion and the ease of steering in a mass of liquid.

The "Nautilus" had the form of a cigar, and was of wood sheathed with copper and hooped with iron. Upon the top there was a dome provided with lenticular ports. The keel consisted of a heavy bar of metal forming a counterpoise and equilibrium.

In front were arranged the anchors, and at the stern were the propeller and rudder, maneuvered from the interior.

Mechanical propulsion was given by the motion of a crank that actuated a wheel with elliptical buckets, situated at the stern.

Upon the top of the "Nautilus" was arranged a mast capable of being turned down upon the hull and carrying a sail.

The "Nautilus" was 21 feet and 4 inches in length, and navigated upon the surface by means of its sail and its propeller.

In order to dive, Fulton brailed up the sail, turned down the mast, and compressed air into the hull, and then, by means of a pump, caused water to enter the hold. The descent took place of itself. In order to ascend, he pumped out the supercharge of water.

As may be seen from the description, this boat fulfilled all the principal conditions demanded by submarine navigation.

Upon a report favorable to these first experiments and those executed in the roadstead of Havre, Fulton was sent to Brest.

The story is told that Fulton, while passing from one of these ports to the other, amused himself by alarming the forts of the coast and surprising the gunners by suddenly diving and reappearing a few minutes afterward in another direction.

On the 3d of June, 1801, he made some experiments in the port of Brest, in navigating in different directions and remaining submerged for more than an hour. On the 26th of the same month he sailed out of the port, and, quickly turning down the mast, dived into the sea and disappeared and reappeared at will in all directions. On his return to the roadstead, he, in the presence of Admiral Villaret, attached a torpedo to the side of a pontoon, which he blew to a considerable height into the air. On the 7th of August, having compressed air into his boat, he was enabled to evolute under water for five hours. When the "Nautilus" reappeared, its crew had in nowise suffered from so long a stay at the bottom of the sea.

Although these experiments seemed conclusive, a more striking demonstration of the power of the boat was required. Fulton waited for a long time for the appearance of an English frigate cruising along the French coast, but it did not come, and the public powers soon lost interest in the inventor and his apparatus. Fulton made new appeals to the French government, but was abandoned. To Napoleon he was but a charlatan and adventurer; but later on the consul had to regret this opinion.

Fulton, however, asked but little: reimbursement for the cost of his boat, 40,000 (from which was to be deducted the 10,000 francs already advanced), and a patent giving him the title of belligerent so as to prevent himself and crew from being hanged in case of capture by an enemy.

It is curious to remark that this request for a patent was one of the causes of the refusal to support Fulton any longer. The Minister of War, Admiral Pleville le Pilley, concluded that it was impossible to give such a patent to anyone who employed such means for attack and defense. Caffarelli, maritime prefect of Brest, expressed the same opinion, and added that such a method of fighting would prove the fatal loss both of those who should direct the attack and those against whom it might be made, and that this would not be a valiant death.

Although Fulton's invention was thrown aside by France, the learned engineer continued his mechanical researches, and, on the 9th of August, 1803, made some experiments upon steam navigation upon the Seine in the presence of a large number of persons, among whom were Bougainville, Bossut, Carnot and Perier, delegates from the Academy of Sciences. These new labors of Fulton in France were followed by no result. Fulton, therefore, left France for England in 1806, and thence sailed for America, where he pursued his studies upon submarine, and especially upon steam, navigation. These latter were crowned with complete success.

Fulton improved the submarine boat and the torpedo in America, and made several remarkable experiments in the port of New York at the expense of the government. He even succeeded in adding to his apparatus a method of severing the cables of ships at anchor by means of a gun that he fired under water. The result of this experiment was so interesting that he put into practice the idea of firing under water guns loaded with balls and bombs. He succeeded in sinking the hull of an old vessel at a distance of a few yards.

We give herewith, from an old document, some illustrations of "Columbiads" or submarine guns. Fulton died on February 24, 1815. Submarine navigation and the torpedo were almost forgotten for half a century, but steam navigation was gradually brought to a high state of development.

In conclusion, we shall repeat, apropos of Napoleon and the first submarine boats, a very original story that we find in a study by C. Evrard dating back to 1830.

Captain Johnson, an Englishman, according to some a smuggler, who had repeated Fulton's experiments for the English Admiralty, conceived the project of removing Napoleon from Saint Helena by means of a submarine boat. He proposed to manage his journey in such a way as to arrive off Saint Helena toward the end of the day. In order the better to avoid cruisers he was to submerge his boat and reach the shore unobserved. Thence he was to dispatch an emissary to the emperor and to wait all the time necessary. His intrepidity and coolness were well calculated to assure the success of the enterprise. Large sums were promised him in case of complete success. Besides, 40,000 pounds sterling were to have been paid to him as soon as his boat was ready to start. But the day upon which a sheathing of copper was to be applied to the hull, it was learned that the illustrious captive was no more.—For the above particulars and the illustrations, we are indebted to La Nature.

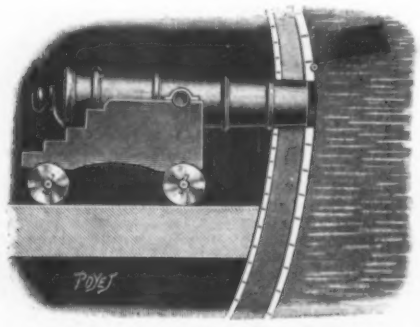


FIG. 2.—SUBMARINE COLUMBIAD OR GUN FOR FIRING UNDER WATER.

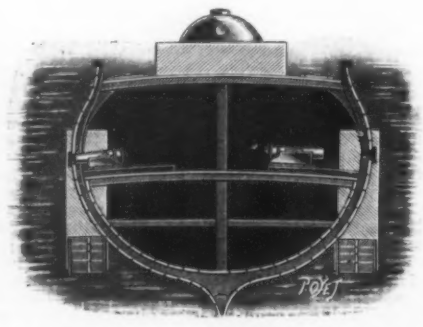


FIG. 3.—INTERIOR OF A SUBMARINE BOAT.

Upon the deck is seen the dome, at the sides the paddlewheels, and, in the interior, the submarine guns.

CALIFORNIA GRAPE GROWERS UNEASY.

According to the San Francisco Argonaut California grape growers are confronted by a most unpleasant situation. The wine crop in France this year is the largest in the history of that country. So greatly does the supply exceed the demand that a good quality of wine is sold at a cent a gallon. With a market ruling so low as this there is no profit for the wine growers, and they began to look around to relieve the pressure. According to our contemporary an invasion of the field built up by California wine growers was the plan naturally agreed upon, and with wine selling at such a low price the tariff afforded no protection to the producers in this country. But still French growers were not satisfied, as cooperage and transportation charges were high. To overcome these they began to ship must instead of wine. Must is the juice of the grape squeezed out but not separated from the grape skins and stems. After expressing, the mixture is passed through vacuum pans and condensed. In this form it is shipped. When it is to be made into wine subsequently water is added, and it is then fermented. One gallon of must will make four gallons of wine, so that three-quarters of the transportation charges are saved. There is sufficient sugar in the must to

preserve it and no alcohol, and, while it pays only 20 per cent ad valorem duty, it might be classed as fruit juice, which pays 60 cents a gallon, but such a ruling has not yet been made. Even this would offer slight relief, according to our authority, says Bradstreets, and, therefore, the grape growers of California have determined to appeal to Congress for aid.

THE CLUCHAGNE SYSTEM OF MILITARY RAFTS AND BRIDGES.

THE devices proposed by inventors for sustaining objects upon water are very numerous. The system invented by Commander Cluchagne, and which has been experimented with under various circumstances, differs somewhat from all its predecessors and is of a nature to be utilized in the army.

In principle, the apparatus is of remarkable simplicity. It consists of cylindrical metal buoys 12 inches in length and 6 in diameter. If two of these cylinders be attached to a gymnasium belt (Fig. 1), we shall have a first-class swimming apparatus. A man can put on such a belt and fasten it around his body in fifteen seconds. Thus equipped, he would be able to save himself in case of danger, or, if need be, afford aid to a person in peril. The ascensional power of the float is such that with it a man can, with all his clothing on, cross a river without knowing how to swim, and that too by merely treading water while his forearms rest upon the cylinder. A person provided with one of these apparatus can sustain two men at once in the water without any fear of being carried to the bottom by the frantic motions of those that he is endeavoring to save.

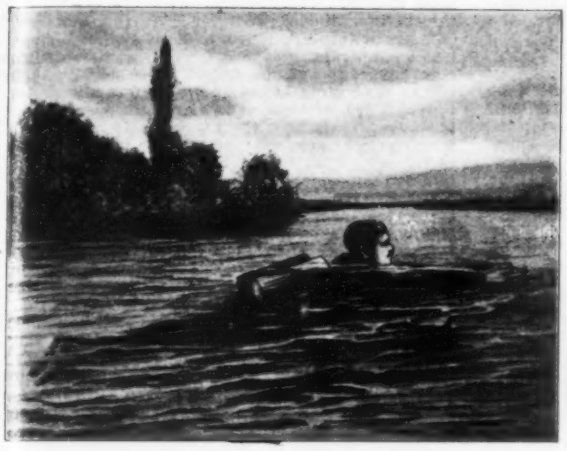


FIG. 1.—FOOT SOLDIER PROVIDED WITH THE CLUCHAGNE SWIMMING APPARATUS.

It will be seen that an apparatus of this kind ought to render great services in swimming. In fact, Commander Cluchagne has experimented with it in this direction in his own regiment. Lessons in swimming have been given in the form of military exercises, the motions being performed upon order, like those executed upon terra firma. Thanks to this method, out of a hundred men composing a platoon of instruction in the 77th regiment of infantry, fifty learned how to swim in five lessons. In this same regiment, also, the number of soldiers not knowing how to swim has descended from 95 to 35 per cent after six lessons.

It is certain that the services rendered to the army by the Cluchagne apparatus would be the same for all persons desirous of learning the difficult art of swimming.

Commander Cluchagne has given his apparatus a wider range and applied it to the crossing of rivers. To this effect, he submits the float to a slight modification that consists in converting it into a buoy of which the two parts can be connected hermetically. Under such circumstances the float renders manifold services. Owing to its form it may be placed upon the soldier's knapsack and hold his spare tunic, so that in case of rain the latter may be kept dry until the end of a march. The apparatus is therefore essentially hygienic. Finally, the two parts of the cylinder may be employed also as pails or kettles during a halt.

Although rivers are never considered an obstacle in cavalry maneuvers, the same is not the case when it is a question of infantry, to which a watercourse, although of small importance, is often an insurmountable obstacle. It is in order to endeavor to overcome this difficulty that Commander Cluchagne has put his buoys to a new use. He unites them through a system of special couplings and thus forms either rafts or bridges. The rafts are employed for the crossing of wide rivers and the bridges for that of narrow watercourses. He begins by uniting the cylinders end to end so as to form tubes as long as may be desired. It then suffices to place these tubes side by side and connect them in order to constitute platforms. In order to give the latter the requisite rigidity, there may be added pieces of wood picked up in the vicinity of the place where the operation is performed. The apparatus is put together upon land, and is not launched until it is entirely finished, whether it be a raft or a bridge. The affair is extremely light, and so a few men can easily carry it to the spot where it is to be put into water (Fig. 3).

FIG. 3.—CARRIAGE OF A BRIDGE 40 FEET IN LENGTH AND 3 FEET IN WIDTH, FORMED OF 243 FLOATS, THE WHOLE WEIGHING 485 POUNDS.

It may be readily seen that the surface obtained by the assembling of these cylindrical boxes does not offer the conditions necessary for the stability of those desiring to stand upright upon them; and this is why these platforms, before being put in service, are covered with branches, plants, grass and light material capable of giving the plane surface necessary.

The rafts formed in this manner may have a length of 10 feet, as in the case of the one represented in Fig. 2, which is composed of 160 cylinders. The raft is navigated by poling. In this way, it has been found possible to carry a load consisting of 6 men, 46 knapsacks and 4 guns, say a total weight of 1,630 pounds —a figure but slightly less than half the dead load that the system would have been able to support.

The bridge constructed with cylinders (Fig. 4) is formed by the union of eight tubes placed side by side. It has been used for the crossing of a river 50 feet in width. As may be seen, 10 men can readily stand at ease upon it. However, if it were a question of crossing by troops on a march, it would not do to let more than four men go over at once, on account of the swaying produced by the motion of their legs.—For the above particulars and the engravings we are indebted to La Nature.

MARINE AND ESTUARINE DEPOSITS.*

A CERTAIN kind of marine deposits are those laid down in shallow water below the low-tide mark upon the continental shelf, which slopes gradually (may be a few, or a hundred miles) from the shore and then drops suddenly; so that the limit between deep and shallow water is taken at the hundred-fathom mark, which in a great majority of instances denotes the edge of the continental uplift. Upon this shelf submerged under comparatively shoal water the greatest part of the material derived from the waste of the land is deposited.

The characteristic deposit of mechanical origin in shallow water is silicious sand—the further out, the finer. All over this zone of shoal water, wave action is perceptible, but amounts to little except close to shore—being nothing near the outer limit, because even in the severest storms wave action does not penetrate a hundred fathoms and in twenty is very slight. In shallow water, wherever areas are stilled from the interference of tidal or wind currents, eddies occur and mud will accumulate. Again, the character of coast waste is a determining factor—whether the coast be river-broken and what kind of material the sea is deriving from the land. Off the coast of Peru at a point devoid of rivers are acres of gravel as much as ten miles out to sea, because the work is all done by the very heavy undertow and what under usual circumstances would be confined to the littoral is thus carried out. On the south side of Block Island is a large area of clay running up from the deeper water and spread on the bottom in comparatively shoal. The material itself of this island and the chain of which it is a part is very largely clay, and the waves attack and eat into them, grind up the clay and spread it out over a bottom which in ordinary cases would be sandy. With a few local exceptions, from Labrador to the southern point of Florida, the continental shelf is everywhere covered with great sheets of sand of immense thickness, which are constantly growing.

Shallow water deposits of organic origin are likewise very important, being mostly materials extracted from sea-water by the lower type of animals; because

* Lecture at the Wagner Institute, Philadelphia, by Prof. W. B. Scott, of Princeton University. Specially reported for the SCIENTIFIC AMERICAN.

FIG. 2.—CROSSING A RIVER ON A RAFT FORMED OF 160 FLOATS.

FIG. 4.—CROSSING OF A RIVER ON A BRIDGE FORMED OF THE CLUCHAGNE FLOATS.

to be a rock-maker an animal must be short-lived, multiply with extraordinary rapidity, and be able to live while a very large part of its organization has been turned into stone through a deposit of lime or flint. One of the most important organic agencies in shoal water is coral—a subject about which there is an extraordinary amount of misinformation. It is usually spoken of as an insect, which it is not—has nothing to do with the insect; is infinitely below it; belongs to the plane of polyps—the organism being nothing but a fleshy or gelatinous sac without perceptible nerves, without particular organs except the digestive tube. Corals are of very many kinds, and a limited number only are important as reef-builders. The solitary corals live at all depths and temperatures in all seas. The compound corals, only, occur in great colonies—often hundreds of thousands of individuals attached together, rather not yet separated; because the coral polyps have two modes of reproduction—the sexual, by eggs, and the non-sexual by budding or division, when simply a part of the older creature grows out into a small body which gradually assumes the size and shape of the parent; though, instead of becoming separated, they remain together; and the two bud again, and so on, until thousands and tens of thousands of individuals imperfectly separated make up that mass called a coral stalk. The way in which these buds are sent off determines the shape of the colony: it may be branched like a tree, or like a shrub in which the branches all rise from the ground, or a dome-shaped mass, like the great brain corals 18 to 20 feet in diameter; so that there is a manifold variety of form and size; but in all of them the work is precisely the same.

We speak of reef-*builders*. This is an utter misnomer; they build no reefs. In school-books the corals are held up as examples of industry for our emulation; they are also frequently taken as the text or pretext of sermons upon the extraordinary value of co-operation and of little things. Corals have nothing whatever to do with the building of the reefs; they know nothing about it; they are no more industrious than an oyster, in whose industry precisely theirs consists. The oyster makes its shell and the coral secretes the lime in its interior, and that is all. The work of reef-building is done by the waves, absolutely: all that the corals do is to supply the material by extracting it in a way they cannot help and have absolutely no consciousness of, thus building in their interior these curious skeletons. The reef-building corals, so-called, are not found everywhere. They can occur only in water less than 20 fathoms deep and whose winter temperature sinks not below 68 deg. F.; nor will they flourish where the water is anything but perfectly clear (if the water be muddy it kills them), nor where it is below the ocean normal standard of salinity (if it be freshened in any way they cannot live); so that a coral reef is never formed across the mouth of a river, because either the river is bringing down mud or is freshening the water by its discharge, and in the most dangerous navigation the mouths of the rivers are always open so far as the coral is concerned. The actual work of reconstruction is performed simply by the work of the waves, within whose limit of action the corals all lie and grow over the bottom just as trees grow on land. In one place the corals are crowded together in dense multitudes; in another, scattered; a third, there are none, just as in the country some trees grow in groves; others, as isolated individuals; while yet other areas are treeless. In heavy storms the waves break these masses of corals and immediately they are broken they become the playthings of the waves and are ground up, from the finest and most impalpable mud to great bowlders many feet in diameter—exactly the same kind of thing you find on any beach, only a different material. The rocks formed around a coral reef are precisely the same in principle as those formed anywhere else, namely, different degrees of coarseness and fineness, except that instead of having sand, mud and clay, carbonate of lime only is produced by this organic process.

One kind of coral rock very frequent among the older rocks of the earth is where the undisturbed corals, growing in some sheltered spot, have the interstices between them filled up by the sand and the mud and are swept out by the undertow into deeper water, and filling in the crevices of these growing corals gradually produce a solid substance, fossil at the heart; because these conglomerations are built up into solid masses hard as flint, which will ring like pieces of steel under the hammer—the sea-water partially dissolving the interior lime, which thus cements the whole together. Another kind of rock is a coral conglomerate piled up and embedded in masses of coral sand and cemented. In reef rock (of cemented coral sand or coral mud), we may have a rock of exceeding fineness, density and hardness, with not a single trace of any organic structure about it. This is particularly important because it proves the fact that a given limestone's having no organic structure visible in it—even with the microscope—is no evidence whatever that the limestone is not of organic origin; since we can here see it formed under our very eyes in a coral reef, and yet careful search reveals not the slighest trace of organic structure. Oölite—beach rock—is a very common one made up of minute spheres of carbonate of lime, the center being a grain of coral sand upon which the water has deposited successive layers of carbonate of lime.

There are three kinds of coral reefs: (1) the fringing reef, which is built close to land, with or without an intervening channel between; and if the channel is present, found shallow and narrow; (2) the barrier reef, built far out to sea, parallel with the shore, which may form as do sand-pits on our coast, like the bars of Albemarle and Pamlico Sounds; like the bar of Long Island Sound, which incloses Shinnecock Bay; or, a fringing reef may be converted into a barrier reef by the coast's subsidence if the latter do not exceed the rate of coral accumulation. The coral cannot live in water more than 20 fathoms deep any better than we ourselves; but as the reef goes up and the coast goes down there may come to be a wide interval between the former fringing reef and the present coast. The great Barrier Reef of Australia is over 1,200 miles long and contains millions of cubic yards of rock produced in the first instance by the agency of the coral and built into its present solid form by the action of the waves. Finally (3) there is—most curious—the atoll, a ring of coral arising from great depths whose life problem has exercised geologists and biologists for many years and is not yet definitely settled. Darwin and Dana, independently, elaborated the theory of the atoll accepted implicitly for many years—that it always began as a barrier reef around an island; that the island gradually sank as the reef developed, and that the final sinking of the island left only a ring of coral above the sea surface. In some few cases this is probably the correct explanation; in other instances it almost certainly is not. In many instances the coral atoll is merely a ring which has grown up around a volcanic cone that did not quite reach the surface. Suppose a volcanic cone coming within 20 fathoms of the surface; corals settle upon it and build a reef with a lagoon in the center (because the reef grows fast on the outside). There the corals live and flourish best in the broken waters of the surf; they die on the interior of the lagoon where the water is still. Where the wave action is greatest the reef grows fastest; consequently, the interior grows slowly and the exterior faster and thus a ring piles up with the lagoon inclosed more or less completely inside. Again, the coral atoll may arise (suggested originally by Murray of the "Challenger") from a volcanic cone several hundred feet below the water. This cone will be gradually built up by the numerous foraminifera which live at the surface and whose infinitesimal shells are all the time sinking down on the bottom; these will gradually build a platform on top of the cone and thus bring it within the 20-fathom mark, whereupon the corals will take possession and build up their reefs as before. These theories, as propounded by Darwin and Dana, by John Murray, of the "Challenger," and by Professor Agassiz, have been the occasion of a great deal of controversy; but the probabilities are all three of them are right: it is not at all necessary that all atolls should be formed in the same way.

Other organic shallow water deposits are those formed by the mollusca or shell-fish which, under favorable circumstances, live on the bottom in infinite multitudes, and which are treated by the waves precisely as coral material would be. Some limestones are made of well-preserved shells which as they die are slowly embedded in the sand or calcareous mud, washed out upon the beach and the whole cemented into limestone. Other shell limestones, modern and ancient, consist of shell fragments of all possible sizes from those of distinct individuality to others ground down into the most impalpable sand and producing organic shales in which the organic structure has been entirely obliterated. Star-fishes and sea-urchins contribute very materially to the limestone of tropical seas, where they are most abundant; and all the star-fishes, brittle stars, sea-urchins, and sea-lilies secrete a skeleton of calcareous plates which, when they die, become scattered over the bottom and add very materially to the formation of limestone: in fact, there are many ancient limestones which are made up entirely of echinoderms.

Under favorable circumstances great limestone plateaus and banks are formed, from all kinds of calcareous marine organisms—corals, mollusca, the echinoderms, foraminifera, worm-like shells as the circula, and even calcareous sea-weeds and other forms growing in great multitudes. Off southwest Florida and the coast of Yucatan are immense banks of limestone fossils occurring in great scales and of an enormous thickness. Pourteles Plateau is a magnificent illustration. The Gulf of Mexico is a region in which marine life flourishes in perfectly incredible luxuriance. The water is warm and contains vast quantities of food; the seas are crowded with living creatures the great majority of which are able to secrete this calcareous matter and which die very speedily; their lives are short, their mode of multiplication extremely rapid; and from southern Florida down to the depth of 250 fathoms the bottom is covered with calcareous deposits several thousand feet thick, probably; because on the coast of Yucatan one of these plateaus has been uplifted a good deal above sea-level and an examination of the material shows it was made up of species of animals now living in the Gulf: in fact, it was done in the present geological epoch. This limestone in Yucatan has been penetrated to a depth of 1,300 feet without exhausting; but it is peculiarly interesting as an example of the formation of marine limestone before one's eyes exactly like the limestone of great antiquity found the world over.

The chemical deposits in shallow water amount to practically nothing. There are a few places, however, where something of the kind is accomplished; as, for instance, on the coast of Asia Minor, where a number of streams coming in from limestone districts bearing carbonate of lime in solution deposit it in the sea; because carbonate of lime is not very soluble in fresh water and still less so in salt water; and naturally these calcareous animals extract for the purposes of their shells, tests, skeletons, etc.

THE DEEP-SEA DEPOSITS

bring us to another category altogether. On the shelf of the great continental platform—the slope running down from the hundred-fathom mark to the ocean depths usually measured by thousands of fathoms—is deposited the very fine material derived from the land and designated by the very elastic name of "mud." The various "muds" are merely minerals divided into an exceedingly fine state so that they are impalpable, like the finest flour; and they differ in their composition and color. All have very large quantities of silica—sand reduced to the most impalpable state of division (sand dust, really); many of them are colored by organic matter, some by iron, and so on. Blue mud generally occurs in temperate and cold latitudes; red mud, in tropical; and there is green mud, derived from the deposition of glauconite—particularly interesting because the same thing we find in the marl beds of New Jersey and the same thing exactly forming in the sea beds off the coasts of California, Georgia, Florida, and many other places. Volcanic muds are found in the neighborhood of volcanic islands; and certain marine muds are simply volcanic minerals in an excessively fine state of subdivision scattered about the sea bottom at some distance from the source of supply.

Among these deep-sea deposits are the pelagic—not derived (except indirectly) from the land: (1) the oozes, namely, exceedingly fine, mud-like deposits made up not of mud but of microscopic objects. First and most important is the foraminiferal ooze. Foraminifera are microscopic organisms that live in the sea—most of them, except for the microscope, far below the limits of visibility in minuteness; some, giant forms visible with the naked eye; but the great majority of those now living are excessively minute and live in the sea, especially in the warmer latitudes, and at the surface; and they are in such unthinkable multitudes—live, multiply, and die so fast—that their tiny shells are raining down on the sea bottom like a continual snowstorm. They are not confined to any particular depth; they live at the surface and fall to the bottom at all depths; but it is only in the deep water that they form the deposits, because near land they are overwhelmed with the sand; out on the continental shelf, with mud; further out the great oceanic bottom from 400 to 2,500 fathoms in depth in all temperate regions is covered with foraminiferal ooze. It is the estimate that 40,000,000 square miles of the sea-bottom is covered with foraminiferal ooze. Below 2,500 fathoms the ooze disappears, because at these great depths the sea water is highly charged with carbonic acid gas; this is the particular solvent of calcareous matter, and the shells are dissolved as fast as they come down.

In addition to the foraminiferal are other organic oozes, for instance: the radiolarial. Radiolaria are simply jelly-like animals which have the power of secreting the most exquisite shells. There is nothing more beautiful in nature than the test of a radiolarian seen under the microscope. It is invisible to the naked eye, but differs from the foraminiferal ooze in being made of flint and not of lime; the radiolarial ooze is found at far greater depths, because silica is not attacked by the sea water; and we find only a comparatively small area of 10,000,000 to 12,000,000 square miles of the sea bottom covered with it.

The diatom is a microscopic plant—a mere speck of protoplasmic jelly with power, however, of secreting a wonderful shell or test of flint, sculptured in the most beautiful way; and these objects are so exquisite that for many years they have been the means of determining the quality of microscopic lenses: a good lens of a given power will show up the pattern of sculpture on a given species of diatom. In the polar regions we find the deep-sea bottom covered with diatom oozes (especially in the Antarctic region); and the diatoms live not at the bottom but at the top: it is the continual raining down of their shells upon the bottom that produces these oozes.

The largest in extent of all the great abyssal deposits is: (2) the red clay, covering an area estimated at not less than 51,000,000 square miles. It gathers on the ocean floor with absolutely incredible slowness—so slow, in fact, that meteoric dust comes to us from outer space and forms an appreciable body; so slow that the bones and shells of extinct animals that died ages ago are still lying uncovered upon the ocean floor. This red clay is derived, as we now know, from pumice—pumice which must come from either submarine or terrestrial volcanoes; because the pumice will remain suspended in the water for many years and float for thousands of miles before it becomes water-logged and sinks. Pumice is a volcanic product and has in it as one of the principal constituents an orthoclase—feldspar—but always some iron; and the decomposition of this pumice on the ocean floor produces, first, the clay, and then stains it red by the oxidation of the iron. This abyssal red clay is found only in the profoundest abysses, usually below 3,000 fathoms; because even where the radiolarial ooze exists we find that the pumice—the red clay—is present at least as a mixture.

ESTUARINE DEPOSITS,

which come next, are trifling—unimportant; the only difference between the rocks of the earth's crust as we find them—the sandstones, slates, limestones, etc.—and the sediments which we have watched and studied accumulate in the seas and lakes, under rivers, etc., is the difference of consolidation: the rocks are hard, the sediments are soft; one is a sand, the other a sandstone; one is of clay, the other a slate, and so on. In order to make the parallel complete—to show that we have really understood the formation of these rocks—we must prove that this consolidation takes place. There are several ways in which it is done, and we can see them going on—may ourselves reproduce them artificially. In the first place, the mere weight of overlying sediment in a very thick mass must produce at least a tendency to solidification. A mass of sediment say thousands of feet thick piles up on a slowly-sinking bottom. The mere weight of that overlying mass must compress the lower layers of sediment until it becomes solid, as you can take sand and put it into the hydraulic press and make a rock of it by mere pressure. Secondly, we have what we can actually study—the operation—in many instances the cementing of these masses performed by the deposition of chemical cements. Thus water-bearing carbonate of lime in solution, as it percolates through the sand (as we can watch it), will gradually cement that sand into a hard rock by the deposition of the carbonate of lime into the interstices of the sand; or, a cement may be silicious and you get a still harder rock where a solution of silica is treated in the same way; or again, it may be a solution with carbonate of iron—it gradually oxidizes and becomes a hematite, and that acts as a very good cement; and we have plenty of marine (red) sandstones which in no respect (i. e., of hardness) can be distinguished from the most ancient sandstone, and the microscope shows exactly the same thing, namely, masses of sand held together by the cement of oxide of iron. Heat, either in the neighborhood of rocks, as lava flows, or the interior heat of the earth, acts as a consolidating agent. When the sea-bottom is sinking with that great mass of sediment many thousands of feet in thickness, the

interior or lower parts of the mass are brought within the range of the interior heat of the earth and heated up until sometimes it produces a semi-pasty condition. This must, of itself, produce consolidation, just as well as the weight of the overlying mass. Most important of all, however, is compression: that is to say, the lateral squeeze that rocks get by the shrinkage of the earth. There is no necessary relation between antiquity and hardness. Some of the oldest rocks in the earth are still sandstone clay: the Cambrian, and Silurian, of Russia, are still lying in many places in undisturbed beds of sand on sandstone and clay on slate, just as soft and coherent as the day when they were laid down. In New Jersey are many sandstones on clay exactly equivalent to that—as many of the hardest granites; although, generally, the older the rock the harder it gets. Rock that is not consolidated and has not been, retains its original horizontal position. No matter how young the rock is, if it has been folded, it is sure to be hard; because compression is necessary to, and is, in fact, sure to produce, hardness.

THE BRITISH ASSOCIATION AT GLASGOW.*

AFTER alluding in a feeling manner to the death of Queen Victoria, the speaker paid a handsome tribute to Lord Kelvin, whom he called a leader in science and industry of the whole world. He then went on to say:

THE SCIENCE OF THE NINETEENTH CENTURY.

Two years ago Sir Michael Foster dealt with the work of the century as a whole. Last year Sir William Turner discussed in greater detail the growth of a single branch of science. A third and humbler task remains, viz., to fix our attention on some of the hypotheses and assumptions on which the fabric of modern theoretical science has been built, and to inquire whether the foundations have been so "well and truly" laid that they may be trusted to sustain the mighty superstructure which is being raised upon them.

The moment is opportune. The three chief conceptions which for many years have dominated physical as distinct from biological science have been the theories of the existence of atoms, of the mechanical nature of heat, and of the existence of the ether.

Dalton's atomic theory was first given to the world by a Glasgow professor—Thomas Thomson—in the year 1807, Dalton having communicated it to him in 1803. Rumford's and Davy's experiments on the nature of heat were published in 1798 and 1799, respectively; and the celebrated Bakerian Lecture, in which Thomas Young established the undulatory theory by explaining the interference of light, appeared in the Philosophical Transactions in 1801. The keynotes of the physical science of the nineteenth century were thus struck, as the century began, by four of our fellow-countrymen, one of whom—Sir Benjamin Thomson, Count Rumford—preferred exile from the land of his birth to the loss of his birthright as a British citizen.

DOUBTS AS TO SCIENTIFIC THEORIES.

It is well known that of late doubts have arisen as to whether the atomic theory, with which the mechanical theory of heat is closely bound up, and the theory of the existence of an ether have not served their purpose, and whether the time has not come to reconsider them.

The facts that Prof. Poincaré, addressing a congress of physicists in Paris, and Prof. Poynting, addressing the Physical Section of the association, have recently discussed the true meaning of our scientific methods of interpretation; that Dr. James Ward has lately delivered an attack of great power on many positions which eminent scientific men have occupied; and that the approaching end of the nineteenth century led Prof. Haeckel to define in a more popular manner his own very definite views as to the solution of the "Riddle of the Universe," are perhaps a sufficient justification of an attempt to lay before you the difficulties which surround some of these questions.

To keep the discussion within reasonable limits, I shall illustrate the principles under review by means of the atomic theory, with comparatively little reference to the ether, and we may also at first confine our attention to inanimate objects.

THE CONSTRUCTION OF A MODEL OF NATURE.

A natural philosopher, to use the old phrase, even if only possessed of the most superficial knowledge, would attempt to bring some order into the results of his observations of nature by grouping together statements with regard to phenomena which are obviously related. The aim of modern science goes far beyond this. It not only shows that many phenomena are related which at first sight have little or nothing in common, but, in so doing, also attempts to explain the relationship.

Without spending time on a discussion of the meaning of the word "explanation," it is sufficient to say that our efforts to establish relationships between phenomena often take the form of attempting to prove that, if a limited number of assumptions are granted as to the constitution of matter, or as to the existence of quasi-material entities, such as caloric, electricity, and the ether, a wide range of observed facts falls into order as a necessary consequence of the assumptions. The question at issue is whether the hypotheses which are at the base of the scientific theories now most generally accepted are to be regarded as accurate descriptions of the constitution of the universe around us, or merely as convenient fictions.

Convenient fictions, be it observed, for even if they are fictions they are not useless. From the practical point of view it is a matter of secondary importance whether our theories and assumptions are correct, if only they guide us to results which are in accord with facts. The whole fabric of scientific theory may be regarded merely as a gigantic "aid to memory"; as a means for producing apparent order out of disorder by codifying the observed facts and laws in accordance with an artificial system, and thus arranging our knowledge under a comparatively small number of heads. The simplification introduced by a scheme which, however imperfect it may be, enables us to argue from a few first principles, makes theories of practical use. By means of them we can foresee the results of combinations of causes which would otherwise elude us. We can predict future events, and can even attempt to argue back from the present to the unknown past.

But it is possible that these advantages might be attained by means of axioms, assumptions, and theories based on very false ideas. A person who thought that a river was really a streak of blue paint might learn as much about its direction from a map as one who knew it as it is. It is thus conceivable that we might be able, not indeed to construct, but to imagine, something more than a mere map or diagram, something which might even be called a working model of inanimate objects, which was nevertheless very unlike the realities of nature. Of course, the agreement between the action of the model and the behavior of the things it was designed to represent would probably be imperfect, unless the one were a facsimile of the other; but it is conceivable that the correlation of natural phenomena could be imitated, with a large measure of success, by means of an imaginary machine, which shared with a map or diagram the characteristic that it was in many ways unlike the things it represented, but might be compared to a model in that the behavior of the things represented could be predicted from that of the corresponding parts of the machine.

We might even go a step further. If the laws of the working of the model could be expressed by abstractions, as, for example, by mathematical formulæ, then, when the formulæ were obtained, the model might be discarded, as probably unlike that which it was made to imitate, as a mere aid in the construction of equations, to be thrown aside when the perfect structure of mathematic symbols was erected.

If this course were adopted, we should have given up the attempt to know more of the nature of the objects which surround us than can be gained by direct observation, but might nevertheless have learned how these objects would behave under given circumstances.

We should have abandoned the hope of a physical explanation of the properties of inanimate nature, but should have secured a mathematical description of her operations.

There is no doubt that this is the easiest path to follow. Criticism is avoided if we admit from the first that we cannot go below the surface; cannot know anything about the constitution of material bodies; but must be content with formulating a description of their behavior by means of laws of nature expressed by equations.

But if this is to be the end of the study of nature, it is evident that the construction of the model is not an essential part of the process. The model is used merely as an aid to thinking; and if the relations of phenomena can be investigated without it, so much the better. The highest form of theory—it may be said—the widest kind of generalization, is that which has given up the attempt to form clear mental pictures of the constitution of matter, which expresses the facts and the laws by language and symbols which lead to results that are true, whatever be our view as to the real nature of the objects with which we deal. From this point of view the atomic theory becomes not so much false as unnecessary; it may be regarded as an attempt to give an unnatural precision to ideas which are and must be vague.

Thus, when Rumford found that the mere friction of metals produced heat in unlimited quantity, and argued that heat was therefore a mode of motion, he formed a clear mental picture of what he believed to be occurring. But his experiments may be quoted as proving only that energy can be supplied to a body in indefinite quantity, and when supplied by doing work against friction it appears in the form of heat.

By using this phraseology we exchange a vivid conception of moving atoms for a colorless statement as to heat energy, the real nature of which we do not attempt to define; and methods which thus evade the problem of the nature of the things which the symbols in our equations represent have been prosecuted with striking success, at all events within the range of a limited class of phenomena. A great school of chemists, building upon the thermodynamics of Willard Gibbs and the intuition of Van t'Hoff, have shown with wonderful skill that, if a sufficient number of the data of experiment are assumed, it is possible, by the aid of thermodynamics, to trace the form of the relations between many physical and chemical phenomena without the help of the atomic theory.

But this method deals only with matter as our coarse senses know it; it does not pretend to penetrate beneath the surface.

It is therefore with the greater respect for its authors, and with a full recognition of the enormous power of the weapons employed, that I venture to assert that the exposition of such a system of tactics cannot be regarded as the last word of science in the struggle for the truth.

Whether we grapple with them, or whether we shirk them; however much or however little we can accomplish without answering them, the questions still force themselves upon us: Is matter what it seems to be? Is interplanetary space full or empty? Can we argue back from the direct impressions of our senses to things which we cannot directly perceive; from the phenomenon displayed by matter to the constitution of matter itself?

It is these questions which we are discussing tonight, and we may therefore, as far as the present address is concerned, put aside, once for all, methods of scientific exposition in which an attempt to form a mental picture of the constitution of matter is practically abandoned, and devote ourselves to the inquiries whether the effort to form such a picture is legitimate, and whether we have any reason to believe that the sketch which science has already drawn is to some extent a copy, and not a mere diagram, of the truth.

SUCCESSIVE STEPS IN THE ANALYSIS OF MATTER.

In dealing, then, with the question of the constitution of matter and the possibility of representing it accurately, we may grant at once that the ultimate nature of things is, and must remain, unknown; but it does not follow that immediately below the complexities of the superficial phenomena which affect our senses there may not be a simpler machinery of the existence of which we can obtain evidence, indirect, indeed, but conclusive.

The fact that the apparent unity which we call the atmosphere can be resolved into a number of different gases is admitted; though the ultimate nature of oxygen, nitrogen, argon, carbonic acid, and water vapor is as unintelligible as that of air as a whole, so that the analysis of air may be said to have substituted many incomprehensibles for one.

Nobody, however, looks at the question from this point of view. It is recognized that an investigation into the proximate constitution of things may be useful and successful, even if their ultimate nature is beyond our ken.

Nor need the analysis stop at the first step. Water vapor and carbonic acid, themselves constituents of the atmosphere, are in turn resolved into their elements, hydrogen, oxygen, and carbon, which, without a formal discussion of the criteria of reality, we may safely say are as real as air itself.

Now, at what point must this analysis stop if we are to avoid crossing the boundary between fact and fiction? Is there any fundamental difference between resolving air into a mixture of gases and resolving an elementary gas into a mixture of atoms and ether?

There are those who cry "Halt!" at the point at which we divide a gas into molecules, and their first objection seems to be that molecules and atoms cannot be directly perceived, cannot be seen or handled, and are mere conceptions, which have their uses, but cannot be regarded as realities.

It is easiest to reply to this objection by an illustration.

The rings of Saturn appear to be continuous masses separated by circular rifts. This is the phenomenon which is observed through a telescope. By no known means can we ever approach or handle the rings; yet everybody who understands the evidence now believes that they are not what they appear to be, but consist of minute moonlets, closely packed, indeed, but separate the one from the other.

In the first place, Maxwell proved mathematically that if a Saturnian ring were a continuous solid or fluid mass it would be unstable and would necessarily break into fragments. In the next place, if it were possible for the ring to revolve like a solid body, the inmost parts would move slowest, while a satellite moves faster the nearer it is to a planet. Now, spectroscopic observation, based on the beautiful method of Sir W. Huggins, shows not only that the inner portions of the ring move the more rapidly, but that the actual velocities of the outer and inner edges are in close accord with the theoretical velocities of satellites at like distances from the planet.

This and a hundred similar cases prove that it is possible to obtain convincing evidence of the constitution of bodies between whose separate parts we cannot directly distinguish, and I take it that a physicist who believes in the reality of atoms thinks that he has as good reason for dividing an apparently continuous gas into molecules as he has for dividing the apparently continuous Saturnian rings into satellites. If he is wrong, it is not the fact that molecules and satellites alike cannot be handled and cannot be seen as individuals, that constitutes the difference between the two cases.

It may, however, be urged that atoms and the ether are alleged to have properties different from those of matter in bulk, of which alone our senses take direct cognizance, and that therefore it is impossible to prove their existence by evidence of the same cogency as that which may prove the existence of a newly discovered variety of matter or of a portion of matter too small or too distant to be seen.

This point is so important that it requires full discussion, but in dealing with it, it is necessary to distinguish carefully between the validity of the arguments which support the earlier and more fundamental propositions of the theory and the evidence brought forward to justify mere speculative applications of its doctrines which might be abandoned without discarding the theory itself. The proof of the theory must be carried out step by step.

The first step is concerned wholly with some of the most general properties of matter, and consists in the proof that those properties are either absolutely unintelligible, or that, in the case of matter of all kinds, we are subject to an illusion similar to that the results of which we admit in the case of Saturn's rings, clouds, smoke, and a number of similar instances. The believer in the atomic theory asserts that matter exists in a particular state; that it consists of parts which are separate and distinct the one from the other, and as such are capable of independent movements.

Up to this point no question arises as to whether the separate parts are, like grains of sand, mere fragments of matter; or whether, though they are the bricks of which matter is built, they have, as individuals, properties different from those of masses of matter large enough to be directly perceived. If they are mere fragments of ordinary matter, they cannot be used as aids in explaining those qualities of matter which they themselves share.

We cannot explain things by the things themselves. If it be true that the properties of matter are the product of an underlying machinery, that machinery cannot itself have the properties which it produces, and must, to that extent at all events, differ from matter in bulk as it is directly presented to the senses.

If, however, we can succeed in showing that if the separate parts have a limited number of properties (different, it may be, from those of matter in bulk), the many and complicated properties of matter can, to a considerable extent, be explained as consequences of the constitution of these separate parts; we shall have succeeded in establishing, with regard to quantitative properties, a simplification similar to that which the chemist has established with regard to varieties of matter. The many will have been reduced to the few.

The proofs of the physical reality of the entities

* Inaugural Address by Prof. Arthur W. Rücker, M.A., LL.D., D.Sc., Sec. R.S., President of the Association.

discovered by means of the two analyses must necessarily be different. The chemist can actually produce the elementary constituents into which he has resolved a compound mass. No physicist or chemist can produce a single atom separated from all its fellows, and show that it possesses the elementary qualities he assigns to it. The cogency of the evidence for any suggested constitution of atoms must vary with the number of facts which the hypothesis that they possess that constitution explains.

Let us take, then, two steps in their proper order, and inquire, first, whether there is valid ground for believing that all matter is made up of discrete parts; and secondly, whether we can have any knowledge of the constitution or properties which those parts possess.

(To be continued.)

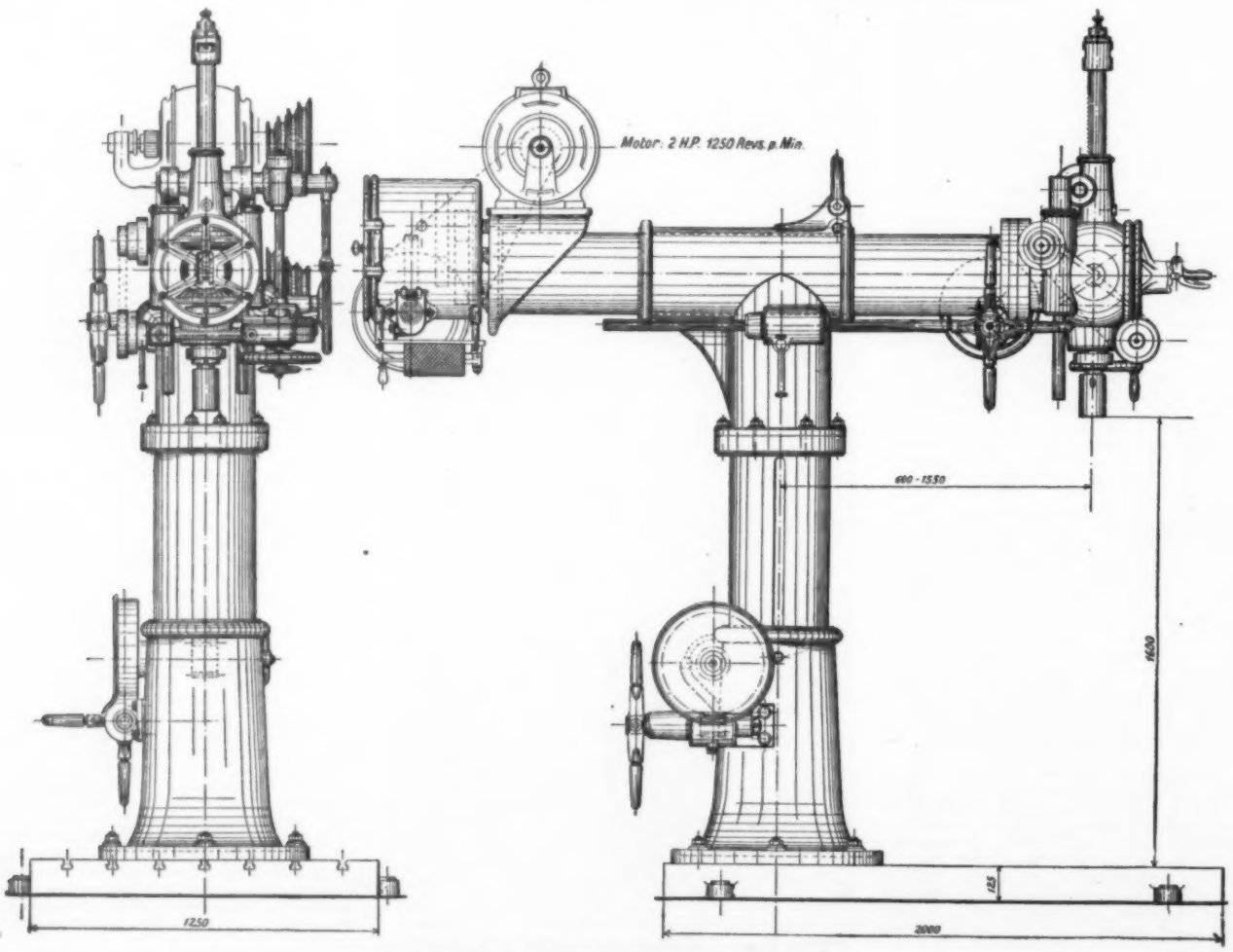
ELECTRIC DRILL.

WE illustrate a type of electrical drilling machine which we think will be found interesting. It is entirely self-contained, and is therefore in a sense portable. It consists of a vertical column about 14 inches in diameter, with a horizontal arm about 11 inches in diameter. The former can be raised vertical about 2 feet, with a maximum distance from the end of the spindle to the base plate of about 5 feet 3 inches. The horizontal bar can be moved longitudinally, or it can be swung like the radial arm of an ordinary machine. The drilling spindle is 2.4 inches diameter, with a stroke of 12 inches, and will drill holes up to 3¼ inches. It can drill at any angle in a vertical circle. A two-horse power motor is mounted on a bracket at the end of the horizontal bar. It makes 1,250 revolutions per minute, and drives a second shaft with worm, which transmits through back gear to the drill spindle. We would call particular attention to the four-step cone used. It is made for a wedge belt, a form of drive which is very popular on the Continent. The drill can be fed down by hand or power, and there are three changes of feed for each speed, of which there are eight. The spindle can be stopped, started, or reversed instantly from the front of the head, so that the machine is suitable for tapping; it has also a quick withdraw motion. The starting switch and resistance are under the drive, of which the gearing is all inclosed, but can be at once got at by a hinged door. Readers who are interested will find little difficulty in making out any other points about the machine from an examination of the illustrations. The machine is made by Maschinen-Fabrik Lorenz, of Ettlingen, Baden.—The Engineer.

ALBANY AND HUDSON THIRD-RAIL ROAD.

THIS is the longest third-rail electric line in the world, being 37 miles in length, says The Street Railway Journal. It is supplied with power from Stuyvesant Falls, which are at a point on the line about 10 miles from one end. There is also an auxiliary steam plant of 1,750 horse power. The electric generators include three 750-kilowatt three-phase generators, working at 25 cycles and 12,000 volts; also two 200-kilowatt 600-volt direct-current generators for supplying the section of the line nearest the power house. The 12,000-volt current is taken by overhead wires to three substations, and is there reduced by transformers to 380 volts, and then supplied to rotaries which convert it into direct current at 600 volts. The power house also contains some single-phase generators, which are used for lighting purposes; these work at 60 cycles per second. The frequency of the three-phase machines is too low for lighting purposes, but was considered the most suitable for use in connection with rotary converters. Hence two different frequencies were used. The track is laid with 80-pound T-rails. The third rail is raised 6 inches above the track, and is supported every 10 feet by wooden blocks. Over these blocks are fitted malleable cast iron caps or chairs, on which the rail rests. The third rail contains less carbon than the other two, with a view to reducing its electrical resistance. Contact with the rail is made by shoes, of which each car carries four, two on each side.

ELECTRIC DRILLING MACHINE.



PORTABLE ELECTRIC DRILLING MACHINE.

These shoes are 31 feet apart, and are arranged in this way in order to meet the interruption of the third rail at farm and road crossings. The shoes are let up or down, swivel fashion, according as current is required or not. The trains are capable of traveling at 50 miles an hour. The article contains several drawings, showing the designs of the station and substations, and the connections on the various switchboards. A drawing showing the construction of the contact-shoe and the lifting mechanism is given in an article in The Electrical World and Engineer of December 8, 1900, and a short description of the line appeared in The Electrician of December 28, 1900.

THE STEAM COACH IN 1825.

By ROBERT I. CLEGG.

THE accompanying illustrations are reproduced from the American Mechanics' Magazine, a journal published in New York city during the early part of the

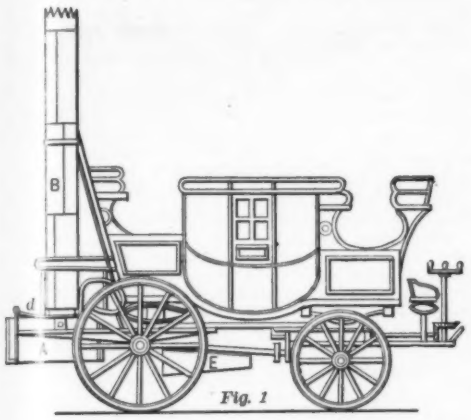


Fig. 1

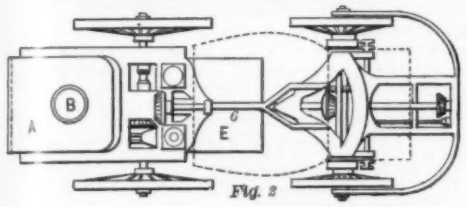


Fig. 2

last century. On the 17th of December, 1825, this magazine reprinted an article from the Edinburgh Philosophical Journal. It is, of course, important to fix the date of original publication as far as possible.

This particular issue of the Mechanics' Magazine is especially noteworthy, inasmuch as it contains a detailed account of one of the earliest attempts at a solution of the several problems incidental to the construction of a practical road-vehicle of the self-propelled type. Earlier attempts had been made in England with a marked degree of success. In France Cugnot, and in this country Fulton had applied steam to the road propulsion of rude trucks; but I am not aware of any earlier and equally detailed description of an actual working automobile in which the inventors have contemplated just such contingencies as even now, in the twentieth century, we are prone to suppose are exclusively for our present-day consideration and settlement. The article is here reproduced and tells its own story, not only as regards the inventive skill of its designers, but also the state of the art at that distant date. Following the article I shall point out some features suggested by the engravings and in continuation of the position stated in the preceding paragraph:

"Among the many and varied improvements of the present age, we have the pleasure of presenting the

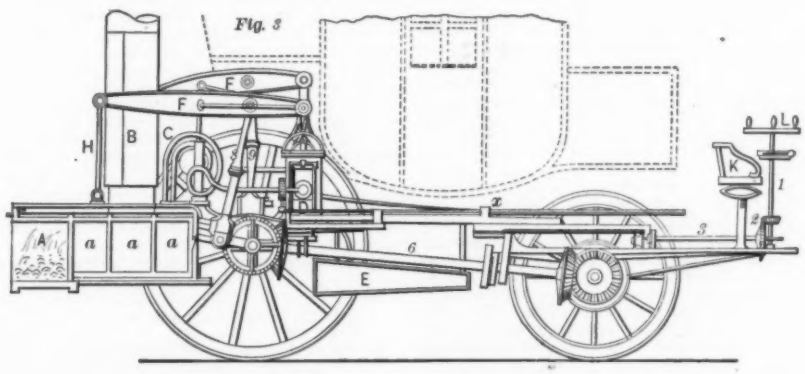


Fig. 3

readers of the American Mechanics' Magazine with the plans and description of one calculated at no distant period to produce a considerable change in the manner of transporting travelers, merchandise and produce by land from one place to another with the greatest expedition and with the smallest expense. The new patent steam carriage, invented by Burstall and Hill, engineers, of England, has been found sufficiently light and powerful to propel itself with considerable force on a level, and with a degree of power sufficient to surmount the hills of any common road. May not this power work as great a change in our land as it has in our water conveyance? We give the description as published in the last issue of the Edinburgh Philosophical Journal, together with the numerous explanatory cuts.

"The invention of a locomotive steam carriage consists in the combination and employment of principles, some of which are new in their application to this purpose, and others well known and in general use. The leading features of the invention may be comprehended under the following heads: 1, The arrangement of machinery, and certain pieces of mechanism, adapted to effect the necessary evolutions of a locomotive carriage. 2. The novel construction of a boiler or generator for the production of steam, and the peculiar kind of pipe or curved passage for conducting the steam to the engine. 3. The mode of supplying the boiler with water, by means of pneumatic pressure, as exhibited in the plans and sections.

"Fig. 1 represents a side elevation of the coach, with the body, etc. Fig. 2 is a ground plan. Fig. 3 is a section, on an enlarged scale, of the boiler and machinery. Fig. 4 exhibits the top of the boiler, with the feed-pipe, and receptacles for water, as will be afterward explained; the dotted lines in this figure show the fireplace and flues, the arrow being in the direction of the flame to the chimney. Figs. 5, 6, 7, 8, 9, 10 are plans and sections of several parts of the machinery with different modifications. Fig. 11 is a plan of the ratchet box and part of the nave. Fig. 12 is a top view of a plate fixed on the spindle of the steering wheel, to indicate to the conductor the angle of obliquity of the two axles. The same letters and figures refer to the same parts of all the plans.

"*A* represents the boiler, which is formed of a stout cast-iron or other suitable metal flue, incased in a wrought-iron or copper case, as seen in section at Fig. 3, where *A* is the place for fuel, and *a a a* are parts of the flue, as seen in section. The top is formed, as in Fig. 4, into a number of shallow trays or receptacles for containing a small quantity of water in a state of being converted into steam, which is admitted from the reservoir by the small pipe, *g g*, while *b b b* is the outer wrought-metal case containing the steam for the use of the engine. *B* is the chimney, arising from the center flue.

"*D D* are the two cylinders, which are fitted up with pistons and valves, or cocks, in the usual way, for the alternate action of steam above and below the pistons. The boiler being suspended on springs, *d*, the steam is conveyed from it to the engines through the helical pipe, *o*, which has that form given to it to allow the vibration of the boiler without injury to the steam joints.

"*F* is the cistern, containing water for one stage, say 50 to 80 gallons, and is made of strong copper, and air tight, to sustain a pressure of about 60 pounds to the square inch. By *e* is denoted one or more air-pumps, which are worked by the beams of the engines, and are used to force air into the water vessels, that its pressure may drive out by a convenient pipe the water into the boiler at such times and in such quantities as may be wanted.

"*F F* are two beams connected at one end with the piston rods, and at the other with the rocking standards, *H H*. At about one-fourth of the length of the beams from the piston rods are two connecting rods, *g g*, their lower ends being attached to two cranks, formed at angles of 90 degrees from each other on the hind axle, giving by the action of the steam a continued rotatory motion of the wheels without the necessity of a fly-wheel. The four coach wheels are attached to the axles nearly as in common coaches, except that there is a ratchet wheel formed on the back part of the nave, with a box wedged into the axle containing a dog or pawl, with a spring on the back of it for the purpose of causing the wheels to be impelled when the axle revolves, and at the same time allowing the outer wheel when the carriage describes a curve to travel faster than the inner one and still be ready to receive the impulse of the engine as soon as it comes to a straight course. The box and pawl are shown separate at 11.

"Figs. 5, 8, 9, and 10 show a different method of performing the same operation, with the further advantage of backing the coach when the engines are reversed. In this plan the naves are cast with a recess in the middle, in which is a double bevel clutch, the inside of the nave being formed to correspond. The clutches are simultaneously acted upon by the rods and small lever, *b*, with the helical springs, *m m*, which, according as they are forced to the right or left, will enable the carriage to be moved forward or backward. To the fore naves are fixed two cylindrical metal rings around which are two friction bands, to be tightened by a lever convenient for the foot of the conductor, and which will readily retard or stop the coach when descending hills. *K* is the seat of the conductor, with the steering wheel, *L*, in front, which is fast on the small upright shaft, 1, and turns the two bevel pinions, 2, and the shaft, 3, with its small pinion, 4, which, working into a rack on the segment of a circle on the fore carriage, give full power to place the two axles at any angle necessary for causing the carriage to turn on the road, the center of motion being the perch pin.

"The fore and hind carriage are connected together by the perch, 5, which is bolted fast at one end by the fork, as seen at Fig. 2, and at the other end is secured by two collars, which permit the fore and hind wheels to adapt themselves to the twist of the road.

"To ascend steep parts of the road, and particularly when the carriage is used on railways, or to drag another behind it, greater friction will be required on the road than the two hind wheels will give and there is therefore a contrivance to turn all the four wheels. This is done by the pair of miter-wheels, 4, one being on the hind axle, and the other on the longitudinal shaft, 6, on which shaft is a universal joint directly under the perch pin at 7. This enables the small shaft, 7, to be turned, though the carriage

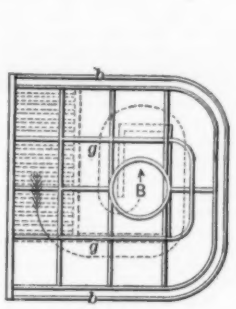


Fig. 4

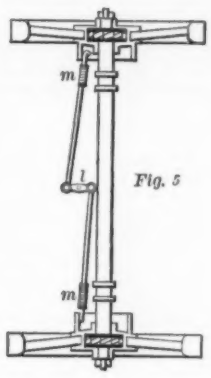


Fig. 5

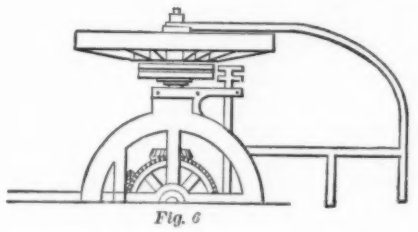


Fig. 6

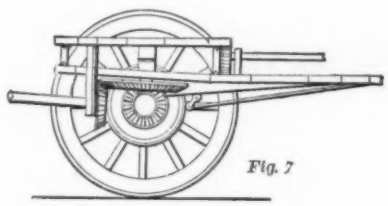


Fig. 7

should be on the lock. On one end of the shaft, 7, is one of a pair of bevel wheels, the other being on the fore axle, which wheels are in the same proportion to one another as the fore and hind wheels of the carriage are, and this causes their circumference to travel on the ground at the same speed.

"Fig. 6 is a ground plan and Fig. 7 a section of another way of impelling all the wheels together, where the perch pin is over the center of the axle. The wheel, 8, is turned upon it, which being put in motion by the wheel, 9, will cause it by means of the wheel, 10, to turn the fore axle and thereby the wheels. There are safety-valves and cocks to admit, shut off, and regulate the steam, etc. But as the engraving is necessarily on a small scale, and such things are familiar to mechanicians, we have thought it unnecessary to cumber our account with them.

"It only remains for us to say that the object of the patentees is, in the peculiar construction of a boiler, to make it a source of caloric; they proposing to heat it from 250 to 600 or 800 deg. Fahrenheit; and by keeping the water in a separate vessel and only applying it to the boiler when steam is wanted they accomplish that great desideratum in the application of steam to the common roads, of making just such a quantity of steam as is wanted; so that when going

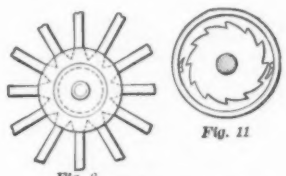


Fig. 11

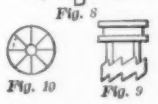


Fig. 8

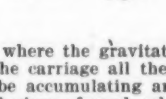


Fig. 10

Fig. 9

Fig. 12

down hill where the gravitating force will be enough to impel the carriage all the heat and steam may be saved, to be accumulating and given out at the first hill or bad piece of road, when, more being required, more will be expended.

"The engines are what are termed high pressure and capable of working to ten horse power, and the steam is proposed to be let off into an intermediate vessel that the sound emitted may be regulated by one or more cocks."—For our engravings and the foregoing article we are indebted to The Iron Trade Review.

AMERICAN LOCOMOTIVES IN ENGLAND.—VI.

By A Locomotive Engineer.

I now come to the matter of materials used by American and English locomotive makers in its bearing on first cost; but I will be brief, as I have previously made reference to this question. Probably one of the largest items of saving in the first cost of American locomotives is effected by the practice in America of using steel plates for the internal fire-boxes, and steel tubes, instead of copper plates and brass tubes, such as are almost universally specified when locomotives are ordered in this country. The suitability of the respective materials for their purpose is, of course, dependent on the conditions under which they are required to work, more especially as regards the water and fuel used. If the water is good, and does not lead to rapid corrosion or the precipitation of thick and obdurate deposits, steel plates and tubes may give fairly good results. But if the engines are liable to be sent, if only now and again, to districts where the water is hard, a judicious locomotive engineer will specify copper fire-boxes and brass tubes. Their first cost is more, but this will be far more than repaid in the long run by the saving of money in the repair and renewals of the boiler, in addition to the important matter of avoidance of loss in the earning power of the engine by its being less frequently in the shops for boiler and tube repairs, apart from the higher scrap value of the materials, which largely recoup the first cost. This item is typical as regards the whole range of materials used in the various parts of a locomotive —whether axles, tires, axle-boxes, motion work, or any other portions of the engine. It is said that the tires of the American engines on the Midland Railway have given much trouble, being probably of too soft a quality, but, having no means of verifying it, I mention it for what it is worth. Soft tires are a well-known source of expenditure in the early life of a locomotive. If the flanges of one pair of coupled wheels wear sharp on account of the tires being too soft, the whole set of coupled wheels have to be re-turned to make them all of equal diameter. But to resume: just as American locomotive makers may save first cost by scrimping details so it is easy to save money by using "cheaper" materials. But however much American engines may be suited for the conditions appertaining to railway undertakings in new and undeveloped countries where lowness in first cost is of more consequence than economical working, the fact remains that the higher class British locomotive, in respect of design, material, workmanship, and finish, is the better and more economical machine in every way in the long run. Let locomotive makers in this country stick to their high-class work and high-class materials, while straining every nerve to diminish the cost of production by the adoption of the best up-to-date appliances, and they need not fear competition with American manufacturers in neutral markets where high-class locomotives are wanted, notwithstanding all that any advocate of the American locomotive has advanced to the contrary.

The English and American systems of locomotive construction are the result of natural causes operating from the very infancy of the industry in each country. In this country the construction of locomotives was taken up by engineers who had already established a name for making high-class machinery, in the belief that good and substantial work was well worth its cost, and they followed the same system in the construction of their locomotives. The plan commended itself to the railway authorities in view of the railways in their charge having been constructed on the principle of making them as good as could be, in order to minimize working expenses, rather than with the object of keeping down first cost. A high standard of quality in locomotive construction was thus introduced into this country, and when, subsequently, the industry developed into a special branch the same high standard was maintained, and has continued to be maintained to this day, British locomotive makers having all along laid themselves out for meeting the demand of the better class railways at home and abroad, to the neglect of those orders in the placing of which low prices were the determining factor.

On the other hand, American locomotive makers began by supplying the demand in their own country for low-priced engines. There the enormous distances traversed by railways compelled the exercise of the utmost economy in their construction, even at the cost of enhanced expenses in working, and the same course had to be followed in the construction of the locomotives and other rolling stock required in working them. This being so, a cheap type of locomotive design and the use of low-priced materials became from the first a governing element with American locomotive makers; and as they have laid themselves out for meeting the demand for this class of engines for new railways in neighboring countries of similarly vast extent, where the necessity for keeping down first cost also largely operates, the practice of American locomotive makers has continued on the same lines. So long as the demand exists for "cheap" locomotives that will not last too long, so that their owners may be free to adopt "something better" when "it comes along," as the chairman of the Midland Railway so well expressed it, the American locomotive builders are not to be blamed for straining every effort to meet it, even if the engines prove costly in fuel, oil, and repairs. Certainly locomotive makers in this country have no reason to complain, so long as it is not asserted that the purchasers of these said American locomotives get as good engines as can be made in this country at £400 or £500 less per engine. The demand for high-class durable and economical locomotives must go on steadily increasing as the railways in new countries become developed and settle down to a method of working more in accordance with the business principles of economy in working at which all well-conducted enterprises must aim if they are to survive competition with rival undertakings. But if the demand for high-class locomotives should die out, British locomotive makers ought to be successful—after a struggle—in dropping down to the lower plane of American locomotive design and "cheaper" methods of construction, and in holding their own at that.

One word more as to the "engine-off-the-peg" remarks of the chairman of the Midland Railway, and I have done. It is a pithy and apt expression, and its importance lies in the fact that it raises a point which tells against locomotive makers in this country from which American locomotive makers are exempt. It is probably not known to the non-technical press, but, in any case, it would astonish even the "superficial thinker" to learn that when the agent of a railway company in need of locomotives comes to this country for engines he ties the maker down to the most rigid specification, not only as to the quality of the materials he is to use in the different parts of the engines, but as to the shape and proportions of the parts, oftentimes down even to the minutest details. The English locomotive maker does not object to the stipulations for high-class materials or workmanship, or to the rigid inspection which the railway company may see fit to institute, because the use of the first-class materials and workmanship is entirely in harmony with his own practice and endeavor. But the practice of requiring not only the larger parts, but every detail of the engine, to be carried out in accordance to the particular predilections of each individual railway company, adds enormously to the difficulties in the way of rapidly turning out work, besides adding largely to the cost of production, for which the railway companies have to pay. If, on the other hand, the user of locomotives goes to America for his engines, he takes them "off-the-peg," designed and executed just as the American manufacturers think fit to make them, as, in fact, the Midland Railway Company practically did two years ago. Little wonder that the American firms, from whom it and the other English railway companies recently obtained engines, were able to deliver them in a comparatively short time. In these circumstances American locomotive makers can safely stock in large quantities the various parts of the engine in slack times ready to meet a sudden demand in busier times, the cost of production being at the same time minimized. If the locomotive manufacturers in this country attempted anything of the kind they would find themselves saddled with parts of locomotives which might long remain on their hands. One would think that it would be in the interests of railway companies and other users of British-made locomotives to agree among themselves as to the form and proportions of details for different sizes of locomotives, as is done by the locomotive men in America.

I must make one more allusion to the remarks of the chairman of the Midland Railway. If Sir Ernest Paget was correct in his description of the attitude of mind of the locomotive authorities on the two lines he is connected with abroad, to the effect that "they absolutely won't look at an English engine," because they have the notion that it won't run well on lines with sharp curves laid with "flat-bottomed rails, fastened direct on to the wood sleepers by spikes, making"—be it noted—"an excellent road for running on," as Sir Ernest described it to the representative of the Daily Mail, the only conclusion we can come to is that they are either very ignorant or lamentably prejudiced. Are they ignorant of the fact that there are, and have been for long years past, thousands of British-made engines working safely and satisfactorily on curving railways all the world over, laid with flat-bottomed rails, of both light and heavy section, fastened direct to the sleepers in the way Sir Ernest Paget described, but not always excellent in the sense of being well maintained.

I think I have now traversed the whole ground of the vexed question of American *vs.* English locomotives as raised by the Midland Railway Company's recent experience, the chairman's remarks on the more general question of their competition with English engines abroad, and Mr. Rous-Marten's article on the subject. I confess to being not quite so free of bias on the side of the English type and make of locomotive as Mr. Rous-Marten, who, I understand to say, would view with perfect equanimity the supplanting of British-made locomotives by American engines, both at home and abroad, provided only they proved themselves the better machines. I hope, however, that I have fairly stated the case from an all-round point of view, and have not overstrained anything adverse to the American engine. If I have unwittingly done so, I have no doubt I shall be promptly corrected.

I also hope that I have succeeded in throwing some light on matters connected with the working and performance of locomotives, which ought never to be absent from the mind when engaged in designing them, as for example, the proportioning of boilers, the use of balance beams, etc. If I have been unable to throw as much light as I should have liked on the cause of the higher consumption of fuel and oil by the American engines on the Midland Railway, and their greater cost for repairs in comparison with their British competitors, it is due to the impossibility there seems to be of penetrating the veil which has apparently descended on the whole question at the very time when, as by a ray of electric light from the office of the Daily Mail, the results of a most interesting trial of American locomotives on a first-class English railway were momentarily brought to view. It is to be presumed that the makers of the engines in question have been duly furnished by the railway company with exact information on all points, which—if of a satisfactory nature—they will doubtless forthwith make public. In the absence of this, it will be interesting to learn what those have to say in defense of the American engines who have either an interest in the matter or feel impelled by a sense of duty on behalf of "truth, fairness, and science."—The Engineer.

W. Zopf has isolated a crystalline carotin, which he names polycystin, from the alcoholic extract of the alga *Polycyctis flos-aquæ*. The extraction with alcohol was effected without heat, and the extract thus obtained saponified with soda solution, and shaken out with ether. On evaporating off the solvent, the coloring matter separated as a mass of micro-crystals, showing, when magnified, fine long needles and leaflets with a metallic luster with reflected light. The spectra of the solutions are different from those of chlorophyl, of carotin, of poppy red, and solanum red. Polycystin does not form compounds with alkalies or alkaline earths. It must, therefore, be classed with the eu-carotins.—Chem. Centralblatt, 72, 466.

SELECTED FORMULÆ.

Kalodont (a la Sarg).—

Dissolve:

Medicinal soap	300 parts
Glycerin	1,000 parts

and finely grind with it

Lime carbonate, precipitated	500 parts
Magnesia usta	160 parts

Next perfume with:

Cinnamon oil	4 parts
Peppermint oil	4 parts

Finally dye pink with 6 grammes of a solution of 0.5 gramme of carmine in 10 parts of water and 0.5 gramme of potassium carbonate.

Rust Paste and Paper.—

Finely powdered emery	50 parts
Graphite	10 parts
English red	10 parts
Powdered pumice stone	15 parts

Knead into a dough with tallow and add petroleum until the mass has acquired the consistency of a paste. Rust paper is produced by coating strong packing paper with linseed oil varnish, size or any other binder and sprinkling on the above powdered mixture. For use the paper must be moistened with petroleum.

Production of Fruit Jelly Extract.—Fill into separate paper bags:

Medium finely powered gelatin	18.0
Medium finely powdered citric acid	3.0

likewise into a glass bottle a mixture of any desired

Fruit essence	1.0

and

Spirit of wine	1.0

and dissolve in the mixture for obtaining the desired color:

Raspberry red	0.1

or

Lemon yellow	0.1

or

Non-poisonous aniline green	0.1

For use, dissolve the gelatin and the citric acid in boiling water, adding

Sugar	125.0

and mixing before cooling with the fruit essence mixture.

Violet Toilet Preparations.—

VIOLET WATER.

(1)	Spirit ionone, 10 per cent	½	drachm
	Distilled water	5	ounces
	Orange flower water	1	ounce
	Rose water	1	ounce
	Cologne spirit	8	ounces

Add the spirit of ionone to the alcohol and then add the waters. Let stand and filter.

(2)	Violet extract	2	ounces
	Cassie extract	1	ounce
	Spirit of rose	½	ounce
	Tincture of orris	½	ounce
	Green coloring, a sufficiency.		
	Alcohol, to	20	ounces
(3)	Tincture of orris	64	ounces
	Tincture of vanillin	16	ounces
	Oil sandalwood	½	ounce
	Oil bergamot	1	ounce
	Oil rose geranium	½	ounce
	Cologne spirit	80	ounces
	Rose water	96	ounces

Dissolve the oils in the spirit; add the tinctures and set aside for three days; then add the water slowly, stirring well, and let stand for two weeks before filtering. Color with chlorophyl or aniline green to the tint required.

VIOLET AMMONIA.

Most preparations of this character consist of either coarsely powdered ammonium carbonate, with or without the addition of ammonia water, or of a coarsely powdered mixture, which slowly evolves the odor of ammonia, the whole being perfumed by the addition of volatile oil, pomade essences or handkerchief extract. The following are typical formulas:

(1) Moisten coarsely powdered ammonium carbonate, contained in a suitable bottle, with a mixture of concentrated tincture of orris root, 2½ ounces; aromatic spirit of ammonia, 1 drachm; violet extract, 3 drachms. (2) Fill suitable bottles with coarsely powdered ammonium carbonate and add to the salt as much of the following solution as it will absorb: Oil of orris, 5 minims; oil of lavender flowers, 10 minims; violet extract, 30 minims; stronger water of ammonia, 2 fl. ounces. (3) The following is a formula for a liquid preparation: Extract violet, 8 fl. drachms; extract cassie, 8 fl. drachms; spirit of rose, 4 fl. drachms; tincture of orris, 4 fl. drachms; cologne spirit, 1 pint; spirit of ammonia, 1 ounce. Spirit of ionone may be used instead of extract of violet.

VIOLET WITCH HAZEL.

Spirit of ionone	½	drachm
Rose water	6	ounces
Distilled extract of witch hazel, enough to make	16	ounces

—The Pharmaceutical Era.

Matches in the Netherlands.—Consul Hill, of Amsterdam, August 1, 1901, says:

There is a good chance for the introduction of American matches into the Netherlands. At present the cheaper grades are imported from Belgium. A better quality, however, is furnished by Sweden. The wholesale prices are as follows: White wood with brown heads, 36 florins ($14.47) per case; white wood with red heads, 38 florins ($15.28) per case; red wood with yellow heads, 45 florins ($18.09) per case. A case consists of 20 packages, each package containing 50 smaller ones of 10 boxes each. Each box is 2¼ by 1½ by ¾ inches, and contains about 75 matches. The import duty is 5 per cent ad valorem.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Coal Hoister at Alexandria.—I have to report another trade invasion of Egypt by Americans, no less important than the securing of the Atbara Bridge contract, which attracted so much attention on both sides of the Atlantic a few years ago.

The greatest work ever undertaken in Egypt in regard to discharging coal from steamers has just been completed in Alexandria. The huge mass of machinery that towers above the surrounding ships owes its origin to Mr. Alexander E. Brown, an American engineer, who has invented a system of suspended bridge tramways, whereby colliers could be unloaded automatically in about one-quarter of the time taken by manual labor and the use of steam winches. The Egyptian Railway Administration decided to adopt this system; the present apparatus is the first that has been installed in Africa.

The hoisters here are alleged to be capable of unloading 2,120 tons of coal in a working day of ten hours. A boat that now takes a week to discharge, will, it is stated, by the help of these coal hoisters, be discharged within forty-eight hours of berthing. These machines will be able to work on two or three ships at a time, and the saving of labor is apparent. There will result an enormous decrease in "small," as there will be no coal dust flying about. Every bit of coal will be put into buckets and carefully unloaded again, none being wasted.

These suspended bridge tramways, or, as they are popularly called, coal hoisters, are each 353 feet 9½ inches in length. They have the appearance of an aerial bridge with a cantilever-arm extension at either end. The method of working is as follows: On a suspended track on the bridge, 14-inch gage, runs a trolley carrying buckets, each having a capacity of one ton. On arriving over the hold of the ship, the bucket is automatically lowered. The buckets can be unhooked, so that three or four can be filled at the same time. When the bucket is filled it is raised again to the trolley and run back and discharged at any point on the quay or into railway trucks. A bucket can be raised from the hold of a ship, put on the trolley, carried to the farther end of the bridge, discharged, and returned to the hold again in the space of one minute. The bridge is 27 feet clear at the lowest part, and the highest part is 72 feet. Each bridge is supported by a pier at the sea end and shear legs on the other side.

The pier allows room for two railway trucks beneath or inside. The bridges are divided into three sets of two in a set, one of which contains a boiler and two engines. These engines operate the trolley and raise and lower the buckets by wire ropes. The engines are of about 25 horse power. Steam is used instead of electricity, as it is more economical, the work not being continuous. Each bridge stands on three tracks, two under the pier and one under the shear legs, and each set of bridges may be moved the entire length of the quay independently, so as to be available in any one of the berths. The operation of each bridge is controlled by one man, and is effected by steam power from the same engine that works the buckets. Each bridge is hinged over the pier and pivoted on shear legs, so that it may be swung to a distance of 23 feet on either side of the center. The object of this is to allow a greater area of the quay to be covered, and it is also useful in preventing the twisting of the bridge in case of slipping of the wheels. There is another automatic arrangement by which the coal below the bridges may be scooped up and loaded into trucks or barges. This is done by a scoop bucket, and is absolutely independent of manual labor. The weight of the entire plant is about 800 tons. All the material is soft steel, combining the greatest strength with lightness.—John G. Long, Consul-General at Cairo.

American Consular Bureau for Switzerland.—The "central office for the preparation of commercial treaties" at Berlin has in a recent circular pointed out as an especially significant sign of the times the fact that elaborate preparations are now in progress for the permanent supply of American coal to northern France and Switzerland. "Already," says the memorial, "the American exporters during the coal famine of last year sent a quantity of coal to Switzerland by the water route via Rotterdam, Mannheim, and Strasburg. But the long distance and the several transshipments caused so much disintegration that it could not finally be used as lump coal for steam purposes." The present plan includes the creation in a port of northern France of an immense receiving station or depot, equipped with modern American machinery, for unloading, screening, and grading coal, and for making briquettes from the refuse dust and slack. For the Swiss trade the French railways have granted a special freight rate of 12 francs ($2.316) per ton, and with this concession it is expected that the American coal will be able to undersell and replace the supply which Switzerland has hitherto drawn almost exclusively from Germany. If all this is true, as announced, there may be an opportunity for an important trade. The imports of German fuel into Switzerland in 1900 were as follows: Coke, 126,210 tons; coal, 1,145,418 tons; briquettes, 307,813 tons; total, 1,579,441 tons.—Frank H. Mason, Consul-General at Berlin.

Ice in France.—Since the publication in the Consular Reports of my recent brief dispatch in regard to ice in France, I have received many letters requesting additional information upon the subject. In almost every instance one of the first inquiries is, "What are the prospects for the establishment of an ice-cream and cool-drink business in the large French towns?" I do not know whether the answering of such a question comes within the sphere of a consul's duty, as the opening of ice-cream saloons and the running of cool-drink establishments by Americans in France would hardly affect the output of United States products, but speaking generally, I should say that as far as Rouen is concerned the outlook for such establishments is good.

A few evenings ago I stopped at one of the largest cafés here and asked for ice-cream. It was served in a little glass about the size of a wine glass. There was certainly not more than three level tablespoonfuls, and of a poor quality at that. The cost was 20 cents. There are only two or three places in this city where cream is served. In order to make such a business pay, a great deal of patience would have to be exercised. In Normandy, new ideas filter into the people's minds very slowly, and the person who opened an ice-cream saloon would, in the beginning, be regarded with suspicion. Then, there is a deep-seated prejudice against cool things, and physicians, generally, say that ice is most injurious to the health.

Another question which has been repeatedly asked is: "Can ice be had at a reasonable price, and if not, would a small ice-making plant pay well?" Undoubtedly, a market exists in many of the larger cities of France for ice-making machinery of American manufacture. As a natural consequence, all else connected with the comforts of cool living in hot weather would follow the introduction of these machines. This spring a Mr. Patterson, an American, established the first ice factory in this city. Heretofore all ice was shipped from Norway, but it cannot be long before such competition must give way to the manufactured product, even though the imported ice is admitted free of duty. A letter received recently from Mr. Patterson will throw some light upon this subject:

"GLACIERES DE NORMANDIE, ROUEN, June 25, 1901.

"My Dear Mr. Haynes: Replying to yours of the 20th, I take pleasure in saying I am the founder of the above-named company, which has been in operation since February. The capacity of the plant is 24 tons per day. The entire plant, including boiler, pipes, and fittings, was purchased from the Vilter Manufacturing Company, of Milwaukee, and too high praise cannot be given them. The entire installation is a perfect success.

"In addition to the above, we have a large cold-storage department operated from the ice plant, but by a separate ammonia compressor.

"This line is new over here, and it will possibly take years to obtain American results, yet they will certainly come sooner or later. Our plant employs twenty hands, including teamsters. We have at present time five wagons, and trust before summer is over to increase this number materially. The competition is Norwegian ice. This ice is delivered in France for little or nothing, and has been sold at retail as low as 7 francs a ton. We, however, take our stand purely on the question of hygienic ice, and believe success will crown our efforts, as the French are keen on hygiene.

"Last year ice retailed in Normandy at 300 francs a ton, and this year, due to our efforts, the retail price is but 50 francs. Yet the clientage has to be made, for up to the present ice has been a luxury that only the rich could afford. The value of cheap ice is little known, and, in a great part, doubted by the people in general. The cost to manufacture ice is about double that of American prices, due mostly to the high price of coal, oils, ammonia, etc. Our company is formed not only for Rouen, but for this entire section of France, and as fast as we can develop sales we will start plants elsewhere. At present we have under consideration but two new installations, as it will require great patience and labor to secure a consumption of an amount equal even to 25 per cent of the American consumption per inhabitant without three plants operating. A more satisfactory letter on this new enterprise will be cheerfully given you in 1902. Very sincerely, A. V. PATTERSON."

A number of persons writing to this office have asked if, independent of the actual making and selling of frozen dainties, a paying business could be worked up in the sales of ice-cream freezers, milk shakers, soda water fountains, etc. I can only answer by saying that such things must follow the general introduction of ice. Judging by the tone of Mr. Patterson's letter one must conclude that a market for these articles is fast being developed. Already refrigerators are making their appearance in Rouen. Only a few days ago I saw, for the first time, a circular, with diagrams and cuts explaining, in French, what a refrigerator was—its principle, object, etc.—saying, among other things, it was exactly like the American refrigerator. The agent for this article is an American, and in all probability he is handling an American refrigerator. I am sure he will meet with success. All over this city are the butchers, the dealers in horseflesh, pork, beef, and mutton. The majority of the people buy only a few cents' worth of meat at a time—2, 4, 6, 10, or 20 cents, perhaps. All during the day the butchers make these petty sales. The serving of ice-cooled meats directly from refrigerators would undoubtedly increase their business and ultimately lead to the introduction of this convenience, not only into private houses, but hotels, restaurants, cafés, etc. However, no firm in America can build up a trade in this line simply by writing a letter to some consulate, asking that the two or three English circulars inclosed be handed to persons who may be interested.

What duties are payable on the articles mentioned? has been asked in many letters. This question is difficult to answer with absolute correctness from the fact that refrigerators are not mentioned in the French tariff. An ice-cream churn, for instance, may be made of zinc and wood; the import duty on the wood would be $1.44 per 100 pounds and on the zinc $1.15. But on such articles the tariff is calculated on the material paying the highest duty; hence, the churn would have to be entered at the rate of $1.44 per 100 pounds. It is difficult to say under what head articles like refrigerators, etc., coming for the first time into a French port, would be classed. Information might be obtained, however, from the collector of customs at the particular port where entry is intended through the medium of the United States consul there.

I have just seen in one of the Paris dailies the following dispatch from London, which seems to indicate that France is not the only field for the development of this American industry:

"In one respect London suffers as no American city suffers—namely, in the lack of ice. Although some millions of tons of ice find their way up the Thames every year from Norway and Sweden, yet the people in London scarcely know its use for domestic purposes. Beyond the supplies to fishmongers, public houses, and grocers there is practically no delivery of ice through London streets all summer. A year ago an attempt was made by one of the largest ice dealers to popularize the use of ice in small quantities among householders. For this purpose wagons were sent around accompanied by icemen offering to sell a pennyworth. The manager of the company said the experiment was only a partial success from the fact that the people had no place to keep the blocks, and in an hour or two they naturally melted. The manager, continuing, said: 'But we expect to try again in a different way. We are going to bring a number of American refrigerators to distribute in various districts of London. These refrigerators will be only ordinary ice chests, such as are used in the households of American cities. The idea is to give an object lesson in the practical use of ice through the summer, as we are confident that it would mean a great saving both in health and in money, and especially among the poorer classes. We do not propose, however, to confine our efforts to the poor, or even to the middle classes. Among the western residences it is astonishing how few ice chests are found. Somehow the idea was never popular in England, and the consequence has been not only an enormous waste of food, but positive discomfort. With American refrigerators in general use, this ought soon to be remedied.'"

The address of this manager is Mr. Been, manager of Slater's Company, London.—Thornwell Haynes, Consul at Rouen.

Wine in Portugal.—The wine crisis in Portugal becomes more and more serious. The quantity of wine now stored in cellars is estimated at more than 132,000,000 gallons, which leaves no room for the storage of this year's exceptionally large harvest. Some producers are asking the government to favor the distillation of a part of the enormous stock and to interdict, temporarily, the entry of the cereal alcohols from the Azores. Other producers ask a provisionary suppression of the tax on internal consumption; but neither of these measures is likely to be taken, especially the latter, as the internal tax on wine constitutes one of the principal revenues of the budget.

A project of law tending to remedy the crisis was proposed to the Cortes in May, but was not discussed on account of the adjournment of that body. The question will probably be settled by royal decree.—Thornwell Haynes, Consul at Rouen.

Extinguishing Fire in Rouen.—Consul Haynes reports from Rouen, July 22, 1901:

The head of the Fire Department of Rouen has suggested to the Mayor a novel project in the fire-extinguishing service. Inasmuch as this city is traversed everywhere by electric street-car wires, it is suggested that there should be provided pumps, driven by dynamos, to take currents by means of a trolley hooked to the street-car wires at the nearest point to the fire. If this is favorably acted upon, as seems likely, Rouen will be equal, if not superior, to any European city in the efficiency of its fire service. Herein is a suggestion for American cities, where street-car wires are much more numerous.

Demand for Farming Machinery in the Netherlands.—Consul Hill reports from Amsterdam, July 31, 1901, that as a result of the increased prosperity among the dairy farmers, there has been a considerable demand in the Netherlands during the last three years for mowers, reapers, binders, and rakes. The difficulty in hiring farm labor at the very low wages offered, he adds, has also had the effect of increasing the purchases of agricultural machines. American plows, continues the Consul, do not meet with favor, German plows being preferred, while horsepower thrashers, the only kind in use, are imported principally from England. The Consul suggests the southern part of the Netherlands as a possible market for fruit driers and fruit machinery.

Refrigerators in Malta.—Malta should prove a good market for American refrigerators and ice chests. The few in use here are of the most primitive type. As a rule they are merely oblong chests, lined with zinc; but even these bring good prices. I believe that the attractive, practical American article would meet with a ready sale, if properly introduced. The three ice factories here could supply all the necessary ice. I do not believe there would be much demand for high-grade goods; the call would be rather for refrigerators which could be placed upon the market at, say, $15 or less. The few in use here are principally of English manufacture, brought from England by private parties. They are not on sale at the local stores. Malta has direct steamship communication with New York. The Valletta firms most likely to be interested in the introduction of refrigerators are: C. Breed Eynaud & Company, Robert Balbi & Company, M. A. Crockford & Son, Mortimer & Company, Dalzel & Gingel, Bugeja & Micallef, C. V. Galea & Sons, S. Anastasi & Sons, Emanuele Anastasi, P. Galea & Sons, Francis Balbi, and the Petrolea Bazaar. I would advise that catalogues, printed in English, be forwarded to them at once, together with the lowest export prices.—John H. Grout, Consul at Valletta, Malta.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1143, September 23.—Zinc and Manganese in New South Wales—Imports of Machinery into Norway—The Malaga Jordan-Almond Crop—Co-operative Workshops in Germany.

No. 1144, September 24.—Horse Meat in Vienna—Rouen Exhibit of Fabrics—American vs. French Silk Industry—American vs. Roumanian Petroleum in Greece—Cables and Telephones in Greece—South Australian Apples in Vienna.

No. 1145, September 25.—*Conditions in Manchuria—Census of Germany—The Metric System.

No. 1146, September 26.—Mineral Resources of Malaga—*Incrustation of Boilers—*Labor Conditions in Germany.

No. 1147, September 27.—Electric Power in Belgian Coal Mines—Steam Heating and Plumbing in Germany—Lace and Hosiery at Nottingham—Argentine-Brazilian Trade Treaty—Quinine Sale in Batavia—Belgium Glass Workers for the United States.

No. 1148, September 28.—Wall Paper in Southern France—Trams and Telephones of Bangkok—Trade Notes from China—Archæological Congress in Athens—Rubber Culture in Perak.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

New Process to Render the Use of Acetylene Cheaper and More Productive.—The object of the new process is to cheapen the employment of acetylene and to increase its usefulness. The process consists in conducting acetylene, with exclusion of air, over very volatile hydro-carbons, such as petroleum, ether, gasolene, etc. Thereby acetylene is diluted, without being charged with other gases, and is thus rendered suitable for many purposes for which it has heretofore been unfit.

A well-known process is to mix acetylene, for dilution, with other gases, such as carbonic acid, nitrogen, etc., but through this treatment acetylene is made to contain ingredients which do not at all enter into consideration for lighting and heating purposes and which not only exercise an unfavorable influence on the illuminating power of the gas but also considerably increase the combustion products, thus materially deteriorating the air in closed rooms much more than pure acetylene gas. It has also been attempted to dilute acetylene with combustible gases, but if illuminating gas was employed for this purpose, a gas house was necessary. If, on the other hand, carbureted air was used, a gas-generating plant equipped with motor and weights was required; besides, the presence of air increased the explosiveness of acetylene.

Attempts have likewise been made to thin acetylene with alcohol vapors. The alcohols, however, are so little gasifiable by acetylene that by the cold method a material dilution and modification of the acetylene cannot be attained.

In the present process all the drawbacks mentioned of the former diluting methods are said to be obviated. The diluent itself is a light and heat-giving gas, the dilution does not require a large, special plant and the presence of air and gas is entirely precluded.

The mode of procedure is to conduct the finished acetylene purified in the customary manner through a vessel filled with the hydro-carbon in such a manner that the gas enters from below and rises in bubbles. Another way is to saturate porous bodies with the hydro-carbon and then to cause the gas to pass through rapidly. The gas takes up the vapors, unites with them and then reaches the place where it is used.

The hydro-carbon fumes admixed to the acetylene affect the gas in a most beneficial manner. They particularly render possible the use of acetylene for incandescent lights. Heretofore all endeavors to effect a satisfactory and uniform incandescent light illumination with acetylene have been futile. Acetylene quickly dirties the mantle to such an extent as to render it unfit for use in a short time. Besides, acetylene was very prone to recoil into the incandescent light burner, thus giving rise to the well-known disturbances in incandescent lighting. The acetylene mixed as described with hydro-carbon fumes heats the mantel free from soot and exhibits no tendency to recoil. Owing to this gas mixture being serviceable for incandescent light, the illumination is very cheap, as low as one-half of the cost of all former modes of lighting with acetylene, other things being equal.

The explosive tendency of acetylene is materially reduced by the hydro-carbon vapors, so that another advantage is obtained in this direction and a more prolific application of acetylene is made possible.

The mixture produced as described is likewise well adapted for the running of gas engines in which the use of pure acetylene gas is known to present economical drawbacks.

The addition of the carbureting vessel does not render the former acetylene generators more complicated and only slightly more voluminous. The increase in space, however, is not sufficiently great to preclude the use of transportable acetylene generators.—Zeitschrift für Beleuchtungswesen.

Bleaching of Leather, Ivory, Bone, and Horn.—Tanned leather is known to contain a large quantity of fat and tannin, which have to be removed before bleaching can be done. According to Borntraeger proceed as follows: First digest the leather at 40 deg. C. for one hour with benzine, pour off, remove the benzine by heating in the water bath and then treat with liquid sulphurous acid, or eau de javelle, or hydric peroxide with ammonia, etc. In every case a very excellent product will be obtained, of a pale pinkish-white shade, which, carefully dried, is well adapted for album covers and fine hand-made articles. In this case the iron is present as ferric oleate or tannate, both of which are soluble in benzine.

In bleaching ivory, horn, or bone one may kill two birds with one stone by preparing an essential hydric peroxide by agitating the latter with ether or with benzine; the peroxide passes into the ether or the benzine. Separate by a separating funnel and treat the ivory, horn, or bone with this hydric peroxide containing about 50 volumes of oxygen. Thus the grease is dissolved and the bleaching is done at the same time. Naturally this mode of bleaching is very expensive, and is commendable for fine work only.—Deutsche Chemiker Zeitung.

Practical Experience with Alcohol Motors.—Of interest to the automobile industry are the following data furnished by Engineer Ad. Delkers:

The superiority of the alcohol motor to other heat generators as regards expense is proved by the following table, based upon a 10 H. P. motor:

Material.	Medium Consumption in Kilos or Liters.	Unit Price.	Price per H. P. Hour.
Alcohol....	0.4 kil. = 0.47 lit.	1 lit. = 19.7 pf.	9.26 pf.
Benzine...	0.35 lit.	1 kil. = 38.0 pf.	13.30 pf.
Petroleum.	0.4 lit.	1 kil. = 25.0 pf.	10.00 pf.

It follows that alcohol containing about 20 per cent of benzol and petroleum are approximately equivalent as regards economy, while benzine must stand back. The greater cleanliness, odorlessness and increased working capacity, therefore, seem to make the alcohol motor the most eligible, if one has decided for an explosion motor at all. In agriculture the alcohol motor is likewise cheaper than its competitors, especially if the proprietor has his own distillery. An alcohol motor vehicle uses 2.23 pfennigs worth per kilometer, while a benzine motor carriage uses up 4.36 pfennigs worth of material. The price per effective kilometer-ton is 7.90 pfennigs for alcohol motors and 9.80 pfennigs for benzine motors.—Mittheil. der Zeitschrift fuer Gaehrungsgewerbe.

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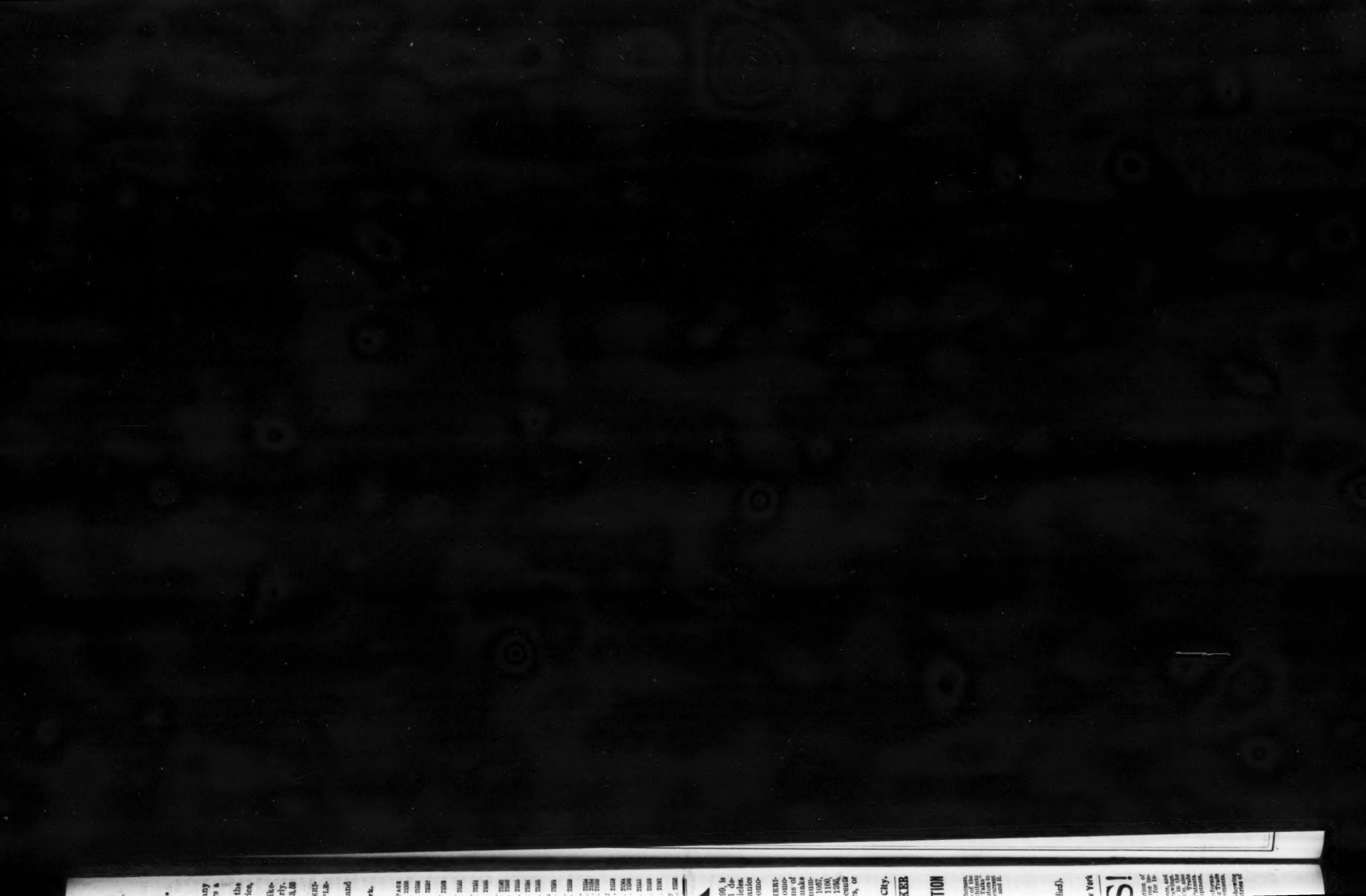
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